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REPORT
OF
JOHN E. FITZGERALD,
RAPID TRANSIT COMMISSIONER,
ON THE
Transportation of Passengers in and
around the Cities of Europe,
MADE TO THE
RAPID TRANSIT COMMISSION OF THE STATE OF MASSACHUSETTS AND THE
CITY OF BOSTON, OCTOBER 16, 1891.

REPORT

OF

JOHN E. FITZGERALD TO THE RAPID TRANSIT COMMISSIONERS.

Boston, Oct. 16, 1891.

GENTLEMEN, — The undersigned, a member of your Commission, having visited various cities in Europe in accordance with a vote passed by you, for the purpose of collecting information as to the facilities afforded for rapid transit either by horse cars or steam, elevated or underground, herewith reports the result of his investigation.

First, he begs to present the horse-railroad and omnibus systems of Great Britain, which are substantially the same as in the larger cities of Europe.

THE STREET-RAILWAY AND OMNIBUS SYSTEMS OF GREAT BRITAIN AND THE CONTINENT.

The street-railway cars of Great Britain and the continent which I have seen are not brought to that perfection in style which has been attained with us. The cars are heavy and behind the times, if the horse-cars of Boston be taken as a standard. There are usually seats on all cars and omnibuses outside, much like the double-deckers in use some years ago on the Highland line. Six companies in Great Britain and Ireland operate over fifteen miles of double-track roads. These are in Belfast, Dublin, Edinburgh, Glasgow, Liverpool, and London; and of these cities the lines in Glasgow and Liverpool are owned by the city and leased to a company,

the company equipping and the city taking care of the lines. This double responsibility has, I am informed, been the cause of a great deal of friction between the city and the railroad company running the lines. The number of miles of horse-railroads in Great Britain is about 1,000, representing a capital of over £15,000,000, of which 400 is double track. They carried last half-year over 350,000,000 of passengers, the North Metropolitan at London alone carrying about 36,000,000 of these.

Their net receipts after all expenses was about £500,000, so that it will be seen the average percentage on the capital invested in street-car management does not exceed three per cent., and in some cases falling much below this.

Herewith I give a table showing the number of passengers and the average price per passenger, together with the average profit per passenger, on eight of the largest street-railways in Great Britain and Ireland for the half-year ending June 30, 1891, and compiled for private circulation:—

	No. Passengers.	Average Fare.	Net Profit per Passenger.
Belfast	7,754,320	1.14	0.18
Dublin	8,251,440	1.69	0.33
Edinburgh.....	7,398,160	1.60	0.20
Glasgow.....	25,746,723	1.92	0.12
Liverpool	16,592,443	1.98	0.11
London	30,527,176	1.18	0.15
London St.....	12,174,904	1.24	0.18
N. London.....	35,615,027	1.31	0.25

From this table it will be seen that the average rate of fare for every passenger who rides on the cars of these largest companies in Great Britain and Ireland does not exceed three cents per passenger, though the fares vary from two cents to eight cents, according to the distance run, which is from one to eight miles. The table given above is accurate, for it was prepared and given me by the Assistant General Manager (Mr. Tresilian) of the Dublin United

Tramway Company. It also shows the enormous amount of penny travel on all these roads, as compared with the long-distance travel. In connection with this matter I was informed by Mr. Anderson, Manager of the Dublin United Tramway Company, that the penny-fare system for short distances increased travel very much. He is a man of forty years' experience in the omnibus and tramway systems. He said: "We have steadily decreased fares since the institution of the tramway system in 1881: the result has been a great increase in our short-distance travel. Our minimum fare in 1881 was threepence, whereas to-day it is only a penny.

"The number of passengers carried during the half-year ending June, 1881, was 4,706,000, whereas the number for the corresponding period of 1891 was 8,251,000. The average fare in 1881 was 2.45 pence; in 1891, 1.69 pence. We have found that our system of low fares and no transfer tickets pays, and we reduce fares wherever we can. Our motto is, 'Cheap fares and no transfer tickets.' To give you an idea how the low-fare system has increased, I give the following statistics from our road:—

" In the half-year ending June, 1886, penny passengers were carried	2,173,000
" For same time in 1891	3,695,000
" In the half-year, June, 1886, twopenny passengers were carried	2,926,000
" Twopenny passengers for same period in 1891	3,089,000
" No. of threepenny passengers, half-year, June, 1886	1,623,000
" No. of threepenny passengers, half-year, 1891	1,296,000

"It will be seen that this is a large increase in travel, owing to low rates, though our city has not increased in wealth or population during that time, but quite the contrary."

Another excellent feature which I noticed is the parcel system, by which the tramway company collects parcels at offices designated by them, and delivers the same at any part of the city, or at any place one mile distant from the end of any route, at prices varying from a penny to eightpence, up to fifty-six pounds. This has proved a source of revenue to the company, as well as a great convenience to the citizens, especially when one considers that the express-company system in vogue with us is not much copied in European countries.

LONDON.

On the great thoroughfares of London, no horse-cars are allowed, but omnibuses take their place, and as a result the blockades, which are so frequent in our cities, especially in Boston, are seldom seen, though on those streets there is a regular up-and-down travel of omnibuses and hansom cabs as closely packed together as carriages in a public procession. They observe the laws of the road, and the uplifting of a policeman's hand is obeyed as instantaneously as the command of an officer in a well-drilled military company. The Strand and Fleet street are much like our Washington street in width and general appearance, indeed more so than any other part of London, or any street in any city I visited. It is well policed. For instance, at the junction of the Strand and Wellington street, which would correspond in its general travel to Washington and Summer and Winter streets, there are four policemen constantly on duty, to avoid collisions and give each person and vehicle a fair opportunity to pass. I went to the Bow-street police-station, and there had an interview with Chief-Inspector Creswell Wells, who explained to me the method by which blockades are avoided and travel facilitated on those streets. By the Metropolitan Streets Act, which applies to the business thoroughfares of London, no person can from ten A.M. to

six P.M. remove ashes, dust, etc., drive cattle, load or unload coal, beer, safes, or heavy material, or drive through those thoroughfares any vehicle containing timber thirty-five feet in length or projecting eight feet behind. The Strand contains more theatres than any street in London, which are close to each other, and yet their system of regulation is so complete that little inconvenience is experienced. To form an idea of the travel on the Strand, I give the following figures, which I copied from the Inspector's books. By actual calculation there passed at a given point on the Strand between two and three o'clock P.M., April 12, 1890, 835 cabs, 264 omnibuses, capable of holding 26 passengers, 153 vans, 12 two-horse carts, 43 carriages, 15 two-horse carts, and 18 trucks, a total of 1,340 vehicles of every kind. From six A.M. to twelve midnight, 14,637 vehicles passed the same point, and during the same time 84,812 foot-passengers. Yet, notwithstanding this enormous travel, there is very little friction, because of the excellent police supervision, stringent laws against loading and unloading heavy teams during business hours, and the absence of horse-cars on these streets. A little of the Strand system applied to Boston would help check the congestion and blockades on Washington and Tremont streets during business hours. As I said before, in none of the cities which I have visited did the horse-car come up to ours, either in Dublin, Liverpool, London, Paris, Brussels, Cologne, or Berlin. They all seem to be built on the same heavy, lumbering pattern. A word, though, may not be out of place as to

THE LAWS GOVERNING TRAMWAYS IN GREAT BRITAIN AND IRELAND.

Great Britain is under a general law known as the Tramways Act of 1870, being "An Act to facilitate the construction and to regulate the working of tramways."

The persons authorized to construct under the act are

(1) The local authorities. (2) Any persons, person, corporation, or company, with the consent of the local authorities. The method by which they proceed is as follows: Application to build a horse-railroad is first made to the Board of Trade, and when such application is approved the Board of Trade causes a bill to be introduced into Parliament. When such bill passes, the promoters build under the general law and are governed by it. No application shall be considered by the Board of Trade where it is proposed to build a road where, for a distance of thirty feet or upwards, a less space than 9 ft. 6 in. intervenes between the outside of the foot-path on either side of the road and the nearest rail of the tramway, if one-third of the owners or occupiers of houses along the line dissent. If a city or town builds or acquires possession of a tramway it cannot run cars and charge tolls, but must lease the road to some person or corporation for a period not exceeding twenty-one years, and with the approval of the Board of Trade. Every road built must be of a gauge 4 ft. $8\frac{1}{2}$ in., unless otherwise allowed, and the rails must be so laid that the upper surface must be on a level with the street-paving. Hence every street-railroad in Great Britain does not destroy the smoothness of the road-surface, as is the case too often with us. Another good provision also is, that they shall not break up continuously more than one hundred yards at a time, and must have a quarter of a mile between each break.

They are also compelled to keep in thorough repair all space between the rails, and eighteen inches on the outside; and where double tracks are laid, they must also keep in repair the space between the double tracks. If after a tramway is in operation for three years the city authorities or twenty tax-payers complain to the Board of Trade that such road does not give proper accommodations, the Board is authorized to allow another person or corporation to run cars over the road for not less than one year or more than three years.

After any railroad has been in operation twenty-one years the city or town authorities may buy the same, and if any disagreement as to price exists, the Board of Trade appoints a competent engineer as referee. But, as I have before said, the town authorities must re-lease, and this generally is given to the original company, as in the cases of Liverpool and Glasgow. The County Council of London has given notice to the London Street-Railroad that they intend to take possession of that road under the Act of 1870; but they doubtless will re-lease it back to that company, as under the act they cannot run the cars themselves, though they will take care of the tracks. The town of Birmingham took advantage of the act, and built tramways in that town, but leased them to different companies who run by electricity, steam, cable, and horse power; and soon that city will decide which of these is best for Birmingham, and compel the several companies to adopt the system decided upon by the City Council.

THE BIRMINGHAM TRAMWAYS, AND THE LAWS GOVERNING TRAMWAYS GENERALLY IN GREAT BRITAIN.

The construction, etc., of tramways is governed, in the first place, by the terms of "The Tramways Act, 1870" (33 and 34 Vic., chap. 78); and, secondly, by the *Special Act*, incorporating and putting into force the *Provisional Order*, which has to be obtained to authorize the construction of any particular route or routes, and which generally applies only to the particular routes therein specified.

Tramways Act, 1870.

The Act of 1870 applies to all tramways constructed since that date; it is divided into three parts.

Part I. contains the details of the mode of procedure by which promoters may obtain a Provisional Order, and conferring large powers upon the Board of Trade in the matter

of the form and general contents of the order. Certain directions are given as to the nature of the contents of the order, its publication after it has been settled by the Board of Trade, and its subsequent confirmation by an Act of Parliament (the "Special Act"), without which an order can have no force. In this part of the act are also defined the conditions under which a "Local Authority," such as the corporation, may obtain an order for the construction of tramways, regulations as to leasing them afterwards, and powers for raising the money to defray the expenses of obtaining the order and for carrying it into effect.

Parts II. and III. are to be incorporated with and form part of every Provisional Order, except in so far as they may be excepted or varied by the said order. Part II. relates to construction; gives power to break up the streets, and to lay tramways over bridges; defines the extent of the roadway the owners of the tramway shall keep in repair; saving clauses as to the protection of gas and water pipes and sewers; and provides for the settlements of disputes, etc.

Part III. contains general provisions as to the carriages to be used on the tramways; directs that the motive power to be used shall be prescribed in the Special Act, and if no motive power be prescribed, then animal power only shall be used; regulations for licenses, tolls, offences, power to make by-laws, insolvency of promoters, purchase of tramways, abandonment and making good the streets, and various other miscellaneous provisions.

Under the powers of this act, several companies have obtained Provisional Orders, and the corporation have also obtained three orders.

Corporation Orders.

The Corporation Order, 1872, authorized the construction of tramways in many streets in Birmingham, and the Order of 1874 extended the time for carrying out the works. Under this order the tramways from Hockley to Colmore

row and Paradise street, and thence to the borough boundary in Bristol road, were constructed. The Corporation Order, 1885, authorized the reconstruction of these tramways, the altering of the gauge from four feet eight and one-half inches to three feet six inches, and took power for working the tramways "by steam-power, or any mechanical power, including haulage, by means of wire ropes or cables placed underground and worked by stationary-engine power." Under this order the Hockley tramway is now worked by cables, and the Bristol-road route by electric accumulator cars.

Other Orders.

The principal of the other orders that have been obtained for the construction of tramways in Birmingham are : —

Birmingham and Aston Orders, 1880 and 1882.

Birmingham and Western Districts Orders, 1881 and 1883.

Birmingham and Suburban Orders, 1882.

North Birmingham Orders, 1884.

Birmingham Central Orders, 1886.

Certain other orders have also been obtained, but the powers conferred by them as to construction have not been exercised.

By the Act of 1870, no order applying to Birmingham can be obtained without the consent of the corporation ; this has only been given on certain conditions, which have usually been incorporated in special clauses inserted in the various orders. The chief of these conditions may be shortly stated as follows : —

Corporation to Construct.

(a.) The corporation to have power to take the place of promoters in all things relating to the construction and maintenance of the tramways within their own district.

Leases.

(b.) The corporation to grant a lease of the tramways, after completion, to the promoters for a term of twenty-one years (the longest term allowed by the Act of 1870), and subject to the conditions specified in a certain form of *Draft Lease*.

Security Fund.

(c.) Before the construction of the tramways is commenced, the promoters to deposit with the corporation a sum equivalent to £2,500 per mile of single line of tramway proposed to be constructed. This fund to remain in the hands of the corporation during the term of the lease as a security for the due payment of the rent of the tramways, and the performance of the covenants and conditions of the lease. The corporation to pay the promoters interest at the rate of three and one-half per cent. per annum upon this deposit (or the balance thereof), and to have power to resort to the principal for making good any arrears of rent, or any other payments that may become due.

Draft Lease.

The "form of Draft Lease" above referred to is signed by the secretary to the promoters, and is accepted by them before the order is made. It defines the terms on which the lines are leased by the corporation, and the rent, etc., to be paid for them. These payments are to be as follows:—

Rent, etc.

First. For the first fourteen years of the lease a sum equal to four per cent. per annum, on the original cost of the tramways, and for the remaining seven years a sum equal to five per cent. on such cost.

Sinking-Fund.

Second. Such a sum as, calculated at four per cent. compound interest for the first fourteen years, and at five per cent. compound interest for the remaining seven years, will amount at the end of the term to a sum equal to the original cost of the tramways. (This payment is nearly equal to three per cent. on the original cost.)

Repairs.

Third. The actual cost (as certified by the City Surveyor) incurred by the corporation in repairs and maintenance of the tramways.

Exceptions.

There are exceptions to the above-named arrangements, both as to the security fund and also as to the annual payments.

In the case of the Aston Tramway Company leasing the lines in Corporation street, Aston street, and Aston road, the Order of 1880 fixed the security fund at £4,000, and the Order of 1882, authorizing a further length of tramway, fixed the additional security fund in respect thereof at £1,450; and in both cases half the amount was to be repaid to the company two years after the tramway had been opened and continuously worked. The corporation have the like power as before to resort to the balance in hand to make good any deficiency in the payments due from the company; pay to the company interest on the sums in hand, and pay over to them the balance at the expiration of the lease. The amount now in the hands of the corporation is £2,725, being at the rate of about £1,350 per mile of single line.

In this case also the rent (which may be taken to include also the sinking-fund) has been fixed at £410 per annum for the first fourteen years, and at £615 for the remaining

seven years of the lease. The first item is equivalent to about six per cent. per annum on the original cost, and the second one to about nine per cent. on such cost. Throughout the term of the lease the company also pay £205 per annum to cover the cost of repairs and maintenance, together with such other sums as the surveyor may determine to be due by reason of the extra wear and tear caused by cars from other routes running over the lines.

There is a further exception in the case of the Hockley cable and the Bristol-road electric routes, both leased to the Central Tramway Company. The amount of security fund is as before stated, viz., £2,500 per mile of single line; but the corporation pay interest thereon at the same rate as the rent is fixed on the original cost, viz., four per cent. per annum for the first fourteen years, and five per cent. per annum for the remaining seven years.

Tramways in Balsall Heath.

By the extension of the city boundaries on the 9th November, 1891, the lines constructed by the Central Tramway Company in Balsall Heath are brought within the limits of the city; but inasmuch as the corporation do not acquire any powers over them beyond those possessed by the Balsall Heath Local Board, the lines will remain the property of the tramway company, and will not be subject to any of the payments referred to above.

Motive Power.

As before stated, the Tramways Act of 1870 provides that the motive power to be used on the tramways shall be specified in the Provisional Order unless nothing but animal power be used. No provision was made in either of the Corporation Orders of 1872 and 1874, nor in the Birmingham and Aston Order of 1880. The Birmingham and Western Districts Order of 1881 first made provision for the use

of "steam or any mechanical power," and the Birmingham and Aston Order of 1882 made the like provision, and extended it to the tramways specified in the Order of 1880. Identical clauses were inserted in all orders up to 1884, and, as above stated, the Corporation Order of 1885 expressly provided for the use of cables on the tramways it authorized. The Birmingham Central Order of 1885 contains a still more comprehensive clause, and takes power to use on the tramways authorized by that order, and also on those authorized by the Birmingham and Suburban Order of 1882, "haulage with wire ropes, cables, chains, or other appliances, or by means of electrical power, steam power, or any mechanical power."

Conditions for Use of Mechanical Power.

There is always inserted in a Provisional Order a clause to the effect that any mechanical power shall only be used with the consent of the Board of Trade, which consent shall not be given for a longer period than seven years at one time. Before this consent is given, the line is inspected, and if not in good order, the permission may be withheld, or given for a shorter period only. On the expiration of the seven years' period on the Aston tramway, in 1889, the consent for the use of steam on the lines outside the city boundary was given for twelve months only; the following year, the lines in the meantime having been relaid with new rails, the tramway was again inspected by the Board of Trade, and consent given for the full period.

Board of Trade Regulations.

The Board of Trade consent for the use of mechanical power is always accompanied by certain regulations, which may be, and which are, withdrawn and modified from time to time, as occasion renders necessary. On the steam routes the regulations provide that every engine used

shall be fitted with proper brake-blocks, and with an automatic governor for shutting off steam, applying the brakes, and bringing the engine to a standstill in the event of a speed of ten miles an hour being exceeded; the engine to be fitted with an indicator to show the speed; a fender to push aside obstructions; a bell, etc., to be sounded as a warning when necessary; to be free from noise and clatter of machinery, etc. The carriages are to be so constructed as to provide for the safety of passengers. Speed at which engine is driven not to exceed eight miles an hour, and not to exceed four miles an hour through facing points, and certain other specified places. Engines and cars to be connected by double couplings; engines to carry two bright colored lights in front after dark and in cases of fog. Besides these regulations are by-laws for the guidance of the engine-driver and conductor.

Cable Tramways.

In the case of the cable tramway, similar regulations are in force. The stationary engine has to be fitted with an automatic governor to prevent the speed of the cable exceeding the specified maximum (seven miles an hour in the city, and nine miles an hour in Handsworth). The cars to have two independent sets of brakes, one being applied to the wheels, and the other set to the surface of the rails; the cars to be furnished with wheel-guards, and no cars to leave the depot unless the grippers and brake connections are in proper working order.

Electric Cars.

In the case of the electric cars the regulations provide that the passengers shall not have access to any portion of the electric circuit; that all wires and connections be of ample size and thoroughly insulated, and protected by safety fuses; and the compartments in which the accumulator cells

are carried to be completely separated from the interior of the car.

Consent of Corporation.

All the Provisional Orders in force contain a clause to the effect that no mechanical power shall be used on the tramways without the consent of the corporation, and subject to such terms and conditions as they may think fit (not being inconsistent with the provisions of the order), no such consent being given for a longer period than seven years. It has lately been the practice for the corporation to give this consent for one year only, and in certain cases for still shorter periods. The conditions on which the consent is given provide that every engine shall comply strictly with the requirements of the Board of Trade; shall be fitted with a "child-protector," or guard, in front; shall not emit sulphurous or noxious vapors, nor allow steam or water to escape on to the roadway to such an extent as to constitute a reasonable ground for complaint by passengers or the public. The conductors of a car are required to remain on the platform in readiness to apply the brakes, while the car is travelling up or down an incline greater than 1 in 25. Companies not to use salt or any chemical material for the removal of snow, etc. There are also other conditions, referring to the cleaning of cars, display of tables of fares, etc.

By-Laws.

Section 46 of the Tramways Act, 1870, gives the corporation, as the local authority, power to make by-laws as to the rate of speed, distances at which carriages shall follow one another, stopping, and regulating the traffic of the road on which the tramway is laid. The same section also gives the promoters or their lessees power to make regulations as to the prevention of nuisances and regulating the travelling upon the tramways. Both as the local authority, and as promoters of the tramways, the corporation have made

certain by-laws. Section 48 of the Act of 1870 gives to the local authority the like power of making rules and regulations affecting the carriages used on the tramways, or the persons in charge of or travelling in the same, as they are entitled to make in respect of hackney carriages, and, accordingly, the rules and regulations made by the corporation under the "Towns Police Clauses Act, 1847," and "The Birmingham Corporation Consolidation Act, 1883," apply to all the cars, etc., used upon the tramways.

Extent of Tramways.

The total length of roads traversed by tramways within the city is twenty-one miles forty-four chains, of which six miles seventy-one chains is laid as single line, and fourteen miles fifty-three chains as double line. The total length, measured as single line, is therefore thirty-six miles seventeen chains. Of this length, two miles forty-one chains (single line) was constructed by the Central Tramway Company in the district of Balsall Heath before the city boundary was extended; the cost of this portion is not known. The balance, being an equivalent length of thirty-three miles fifty-six chains of single line, was constructed at various periods between 1882 and 1889, by the corporation, at a total cost of £169,656, an average cost of £5,040 per mile of single line. The actual cost of the different sections has varied, partly from the nature of the work, but more so from fluctuations in the price of materials; the rails, for instance, have varied in price from £9 to £6 10s. per ton. The lowest cost has been at the rate of £4,750 per mile of single line, and the highest at the rate of £5,800 per mile.

Construction.

In construction a nearly uniform system has been adopted throughout. Girder-shaped rails are used, generally seven inches deep, seven inches wide on bottom flanges, and

weighing ninety-eight pounds per yard; except in two cases, when rails six inches deep and weighing ninety-two pounds per yard were used. In 1882 a length of about two miles of single line was laid with the "Barker" rail, a compound structure consisting of a forty-two-pound steel rail carried on heavy cast-iron sleepers. These were not found to be satisfactory, and have since been all replaced with the heavy section of girder rails. In all cases there is a bed of Portland cement concrete not less than six inches thick under the rails and paving. The paving is generally of granite sets, six inches or five inches deep, according as the rails are seven inches or six inches deep. Wood paving, six inches deep, has been laid on length of about ten miles of single line.

Repairs.

The repairs are a continually increasing source of expense: it is found that for about a year after the line is opened the effects of wear and tear are very slight; but later on the joints in the rails work loose, the paving adjacent to them sinks, leaving the rail as a dangerous projection above the surface. The mischief is caused by the heavy rolling-stock, it being found that on the horse tramway, even in streets of very heavy ordinary traffic, the cost of repairs for several years has been very small. The steam locomotives weigh from nine to twelve tons each, and this load on four wheels is evidently more than the rails will bear without great wear and tear. A loaded car may be taken at six tons, but this load being on eight wheels, is well within the carrying power of the rails. As illustrating the effects of this traffic, it may be mentioned that in Aston road the Barker's rails, laid in 1882, were so badly worn as to be dangerous to ordinary traffic, and had to be taken up and replaced with new after the passage over them of about 275,000 cars. In Hill street, girder rails laid in 1884 had become dangerous, and had to be replaced in the early part of this year after the passage over them of about 625,000 cars. Both these in-

stances are taken from straight lines; on curves the wear and tear is much greater, partly because the wheel does not pass over the rail with a true rolling motion, but with a motion that is partly rolling and partly sliding, and this effect increases very rapidly as the radius of the curve is reduced.

The total expenditure on the repairs of the Birmingham tramways has been as follows: —

							£	s.	d.
In 1884	.	.	.	.	.	.	88	4	0
In 1885	.	.	.	.	.	.	104	4	2
In 1886	.	.	.	.	.	.	1,059	4	0
In 1887	.	.	.	.	.	.	1,397	7	2
In 1888	.	.	.	.	.	.	2,234	8	9
In 1889	.	.	.	.	.	.	4,198	5	0
In 1890	.	.	.	.	.	.	6,787	12	3
Total							15,819	5	4

The total for this year will show a considerable increase over last year.

Costs of Cable Line.

The amount beforementioned as the cost of the tramways is the amount expended by the corporation, and includes all expenses of constructing the lines, except in the case of the Hockley cable tramway. In this case it includes only the cost of the work belonging to and forming part of an ordinary tramway. The tramway company became contractors to the corporation for constructing the line, and had permission to construct it as a cable tramway, providing at their own cost everything necessary for a cable line that was over and above what would have been necessary for an ordinary tramway. The rent and sinking-fund paid to the corporation are those due to an ordinary tramway only.

In addition to the figures above given, it may be mentioned that the total amount deposited with the corporation as security fund is £81,780 7s. 3d.

The total amount paid under the head of rent is £6,928 2s. per annum for the first fourteen years, and £8,762 14s. for the last seven years of the leases. The payments to form the sinking-fund amount to a total of £4,683 17s. per annum during the whole term. The payments for repairs, of course, vary according to the amounts actually expended from time to time.

Birmingham has a population as large as Boston, and the above description of the street-railroads of that city gives a fair idea of the manner in which street-railroads throughout Great Britain and Ireland are built, operated, and leased.

PARIS AND BERLIN STREET-RAILROAD.

In Paris and Berlin the mode of street-conveyance is a combination, like London, of the horse-railroad and the omnibus, and the system of low fares graded from three cents to six cents prevails. In fact, the systems and the style of coaches in all three cities are very similar. I have seen nothing in any of these cities that a Bostonian might envy, so far as horse-car accommodations are concerned, except the penny fares; but our long-distance rides are much cheaper than in either of these cities, especially when it must be remembered that the working classes in any one of them do not earn one-half that which a mechanic receives here.

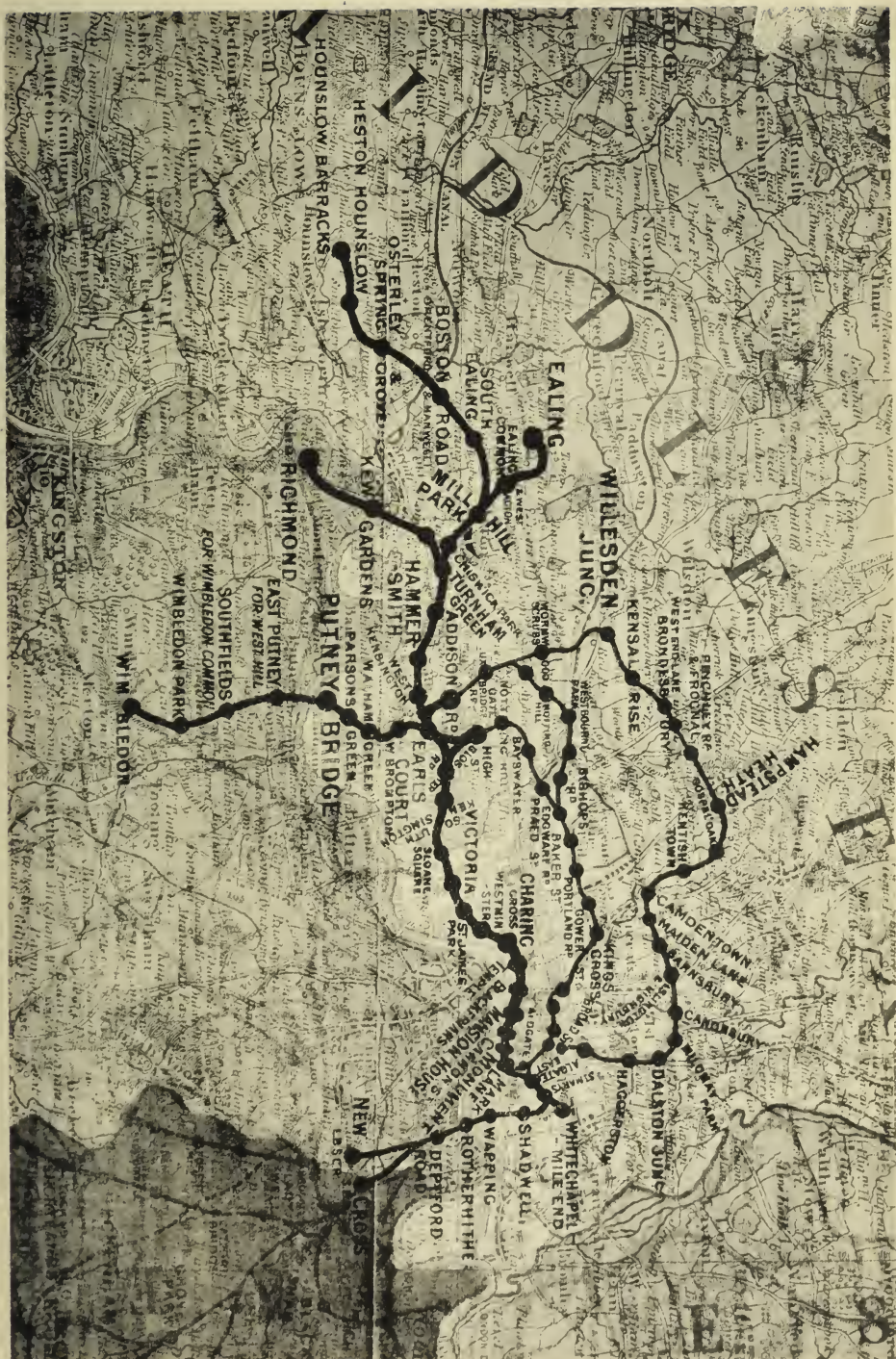
One great advantage, though, which they possess over us is that you are always sure of a seat; for if a horse-car or omnibus has its full complement the conductor admits no more, and you must wait for the next car which has room for "one more." How the system of waiting would please our rapid-transit people in Boston and its suburbs is another thing. It may be worth an experiment here. In all those cities cars and omnibuses run in every direction, and at right angles as well as on parallel lines, thus affording easy transit from any one section to any other. This feature Boston

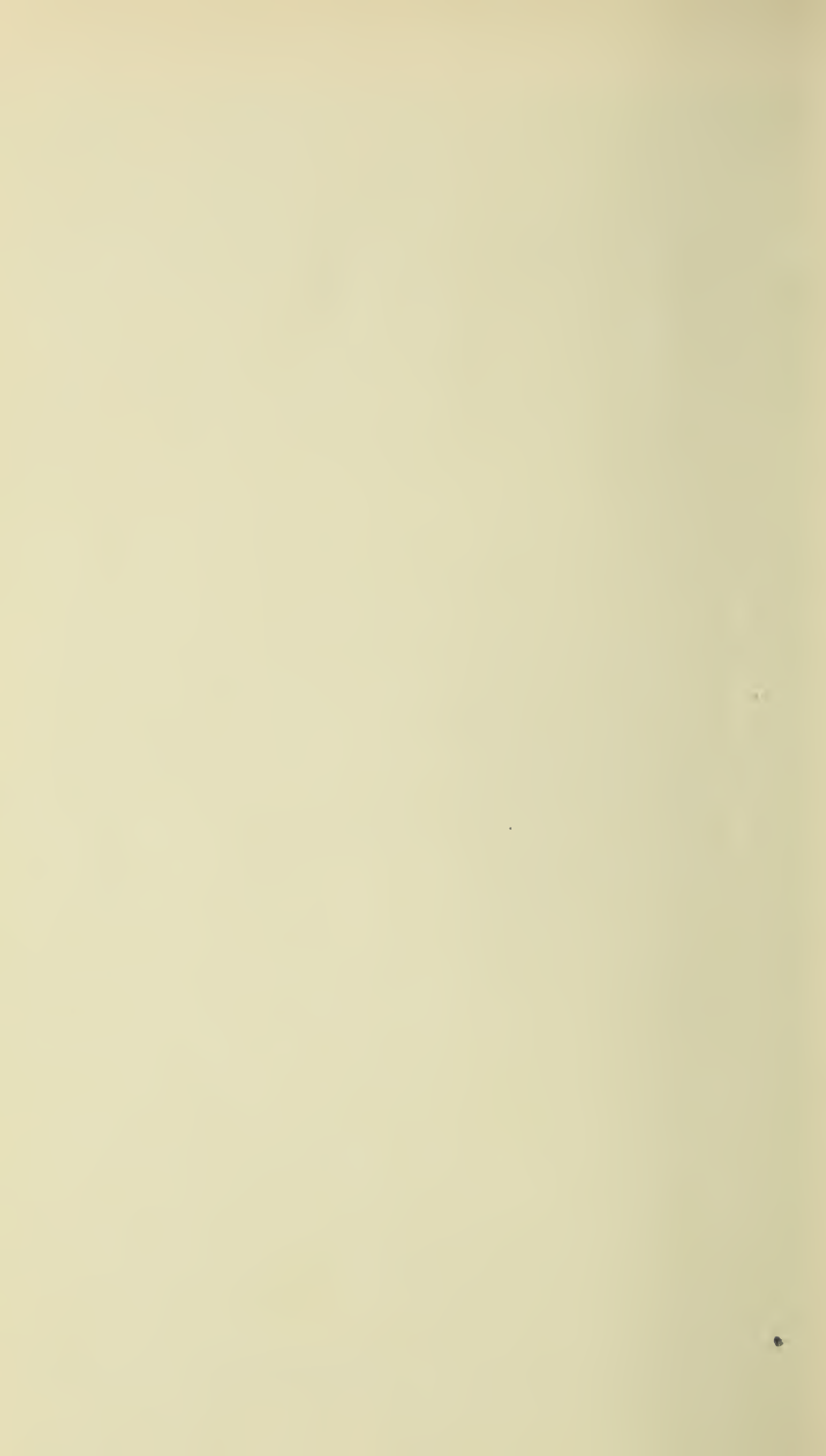
lamentably lacks. There is very little difficulty with us in travelling north and south, but a total lack of accommodations when one desires to cross Boston in an easterly and westerly direction. In addition to all this, there are the hansom cabs of London and the cabs of Paris and Berlin, which seem to be omnipresent, and which transport passengers for very low fares, and are used more generally than with us. For one shilling in London two or more persons can ride quite a distance, and for about forty cents an hour in either Paris or Berlin two or more can hire a cab. So much for the street system. But these are not all the convenience and facility for travel which the people of London, Paris, and Berlin enjoy, London and Berlin especially. They have a circular system of either underground or surface railroads, affording quick transportation from the suburbs to the city, and from any station on the line of these circular roads to any of the great railroads that go from the city throughout the country. In addition to this, the city of Berlin has a grand elevated railroad-structure of four tracks running east and west and halving it, and thus solving effectually the question of rapid transit, not only for suburban, but for through travel also. A description of these may not be out of place. I will first begin with the underground railroad system of London, which is operated by two companies known as the Metropolitan and District Railway Companies, but which for our purpose I shall speak of as one company.

LONDON. — THE UNDERGROUND STEAM-RAILROADS.

The Metropolitan and District Railroads are run round the business section of London, and have intercommunication with each other, and form what is called the circle, which is about thirteen miles round, and operate about sixty miles of road. They have been in operation over twenty years, and are double-track underground roads, with stations about half a mile apart. They were originally intended to accommodate local traffic, but after being in operation some time

MAP OF THE METROPOLITAN UNDERGROUND RAILROAD, LONDON.





they discovered to their cost that one was built too far north and the other too far south of the business streets of London, such as the Strand, Fleet street, Cheapside, Oxford street, and Piccadilly. The result was that these roads lost the short-distance travellers on those great thoroughfares. People preferred taking the omnibuses, with their penny-a-mile rides.

To prevent utter bankruptcy they had to look out for suburban extensions, and the result has been that they are to-day connected with many of the great railroads that run into London; some of them, as the North Western and Great Western, actually running their cars over these two roads at intervals of fifteen minutes. The actual service of the road is one train every five minutes, capable of carrying from three hundred and fifty to four hundred passengers. Beginning at the East End of London, those lines connect with the Great Eastern Railroad at Liverpool street. Then there is a junction with the Great Northern & Midland at Blackfriars bridge. At Charing Cross the station is right under the South Eastern, on which so many people travel to Dover and thence to the Continent. The South Western also runs through this road. This road runs to Southampton.

At the Victoria station they connect with the London, Chatham, & Dover road and the South Coast Railroad. At Willesden Junction they connect with the North Western, which will take passengers to Liverpool, Glasgow, Ireland, etc. At the Praed-street station they connect with the Great Western's terminus, and at King's Cross with the Midland & Great Northern. So that it will be seen that these roads, together with having a large suburban travel, have also intercommunication, or land passengers at or close to the great railroad stations that run from London in every direction, and also book passengers at their stations to distant points in the empire. And yet, notwithstanding all this, the average fare per passenger did not exceed two and a quarter pence last year, though the District road extends

seventeen miles. The cause of this is, that for local traffic in London they are obliged to run penny fares in the heart of the city, to prevent the omnibus lines from securing all the traffic. The result is that the District road is about £40,000 behindhand every year, and what they would receive were it not for the omnibus competition on short routes was shown by the fact that, during the omnibus strike last year, their receipts increased £4,000 per week, or \$1,000,000 per year. This great traffic they lose because they are off the line of business streets. The General Manager laid particular emphasis on building expensive undertakings like underground or elevated roads near the line of business travel, as it will be the measure of profit or loss, as in the case of the London underground roads. I travelled over this road several times, and found it did not contain so much smoke as I expected, because not only do they burn smokeless coal, but their engines also consume their own smoke. In addition to this they have open spaces wherever it is possible, and the inconvenience from carbonic gas and a fetid atmosphere is reduced to a minimum, though this underground road has not the method resorted to for introducing fresh air that prevails in the Mersey tunnel at Liverpool, which is one of the most perfectly ventilated underground railroads in the world.

The cost of the Metropolitan underground road varied from £600,000 to £900,000 per mile, according to location and land damages paid. Its management is perfect, but it labors under the disadvantage of running round the city, and is not near enough to the business section of London to compete with the omnibus and tramway lines, and as a result is not a paying concern, notwithstanding the fact that it carries about 120,000,000 passengers yearly. What is needed in London is a line that will divide the circle in two, and this the proposed underground Central London Railway will attempt to accomplish. They have cheap fares

from five to eight in the morning, and the underground electric has penny fares from six to eight A.M.

To give an idea of how those underground roads accommodate passengers who desire to take long-distance travel, I copied some of the notices at their station.

St. James Park.

"Intercommunication at Wimbledon with the London and South Western Railway."

Here is another notice : —

"Victoria Station.

"London and North Western Railroad trains leave this station every half-hour, connecting with express-train service to Liverpool, Manchester, North Wales, Ireland, and Scotland."

On the cars of the London and North Western lines which run on this underground road I read the following list of stations at which they stopped, posted on the cars : "Broad street, Willesden, Kensington, and Mansion House. Change at Willesden for main line."

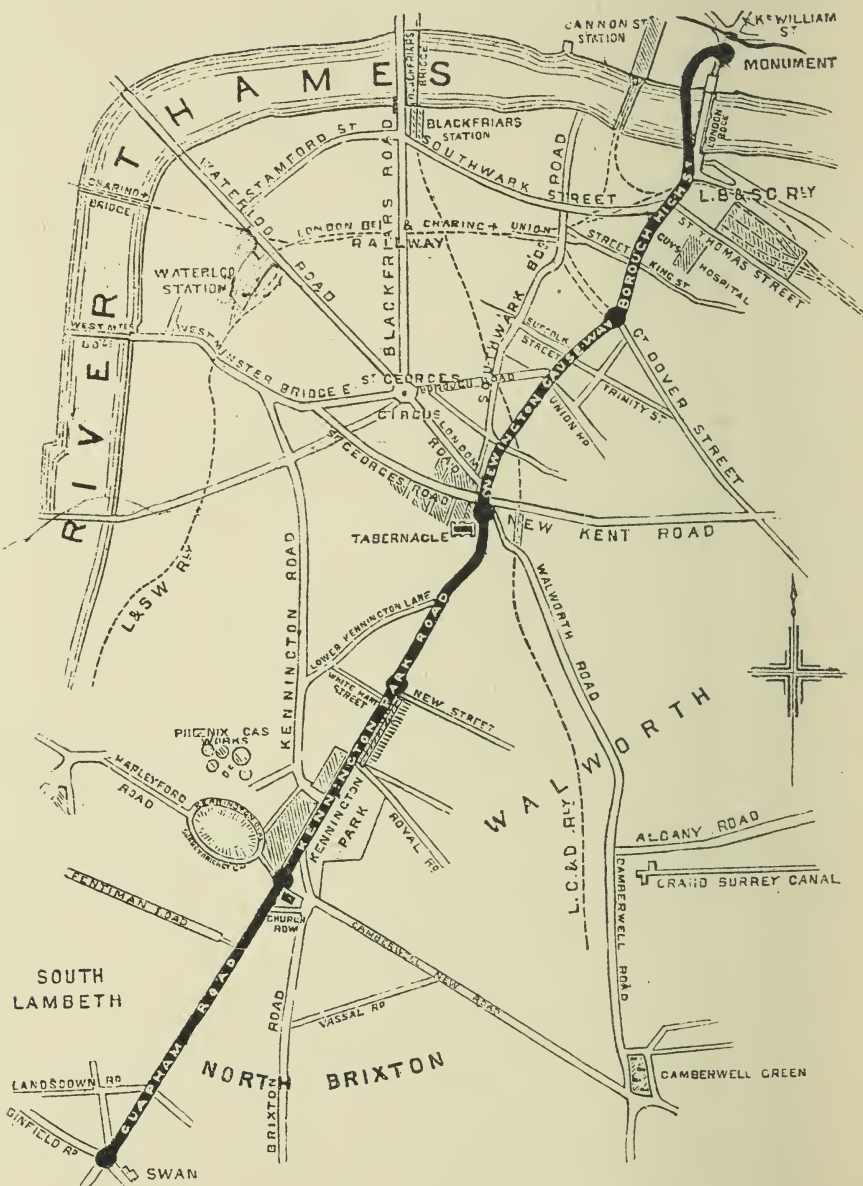
Interview with Assistant General Manager of the District Road.

The following interview with the Assistant General Manager of the District underground road will be of interest : "The circle round which we operate in conjunction with the Metropolitan Railroad is thirteen miles in length, and takes nearly one hour to travel through. In conjunction with the Metropolitan we operate sixty miles of road, and carry over 2,000,000 passengers a week. Our road cost from £650,000 to £900,000 a mile, and is in operation over twenty years. We have for six years paid no dividends, notwithstanding our enormous travel. The longest trip on our roads is seventeen miles, but owing to the enormous

penny-travel we do not average two and one-fourth pence a passenger.

"For years, by an understanding with the managers of the London General Omnibus Company, we agreed with them on a fixed price for local traffic and short trips, but some few years ago a new company was started called the Road Car Omnibus Company. They started penny fares on the Strand and Fleet street, and from Charing Cross to Piccadilly. The result was, we were also obliged to come down from twopence and threepence to penny fares, on our short-distance travel, and this has been continued. We then sought other means of feeding our road, and our policy for years has been to connect as much as possible with all the railroads running into London; and where we do not run into the stations, or they into ours, we always try, for the mutual advantage of both, as at the Victoria and Charing Cross, to have stations near, with porters ready to transfer passengers and luggage. We burn smokeless coal, which we get in a certain locality in Wales, and our engines are so constructed as to consume all their smoke, and thus avoid as much as possible the complaint so often made about smoke in our tunnels. Wherever we can we have open-air spaces; we have them, as you have no doubt seen. On the outskirts our road, though under the ground level, is open. We run cheap trains morning and evening, from five to eight o'clock. We are saddled with a perpetual debenture debt of six per cent., and some of the money which built our road we borrowed at a discount of thirty-seven per cent. This road we built when rates of interest were high, and we have to contend with paying this high percentage, and as a result, and for the other reason I mentioned, we are unable to pay any dividends. The Great Western and North Western run their trains over our roads, and we connect directly with other roads, and are thus enabled to embark our passengers from any part of London, throughout England. We labor,

THE CITY AND SO. LONDON RAILWAY.



MAP OF ROUTE.

however, under the disadvantage of having our *Circle* stations too far removed from the business streets of the city, thus losing the immense local travel on the Strand, Fleet street, Piccadilly, Regent and Oxford streets. Expensive roads like underground or elevated roads should have their stations near to, and should be built on, the line of great thoroughfares. Ours are along the Thames, where there is very little local traffic, and the stations of the Metropolitan are as far or farther north of the great travel. If we could cut our circle in two we then could compete with omnibuses, etc."

I saw the General Manager, Mr. Alfred Powell, who was most courteous, and who explained to me the whole workings of the road. His conversation was in a line with that of his assistant, heretofore given. I herewith present a map of the Metropolitan and District railroads, showing the different stations on the circle and the lines of railroads with which the underground system connects, as also the last semi-annual report of the District road, giving in detail all the business done by it for the half-year ending June 30, 1891. This map also contains the route of the recently constructed underground electric railroad which runs from King William street, under the Thames, to Clapham in South London, a distance of three and one-half miles, and is popularly known as the Greathead road, but its legal name is "The City & South London Railway," a description of which and the method of its construction may not be out of place here. It is in operation now nine months. Recently a charter was granted a company to build a road similar in construction to the South London road, and under the business streets of London for a distance of seven miles.

The Greathead Underground Electric Roads of London.

A bill was passed at the late session of Parliament authorizing the building of an underground railroad to be known as the "Central London Railway." It is to run

under the business section of London, and will cut in two the circle, so called, around the city made by the Metropolitan and District underground steam-railroads of London. It will be seven miles long, and will extend from the Mansion House through Cheapside, Newgate, across Holborn Viaduct, Oxford street, Bayswater road to Shepherd's Bush, in almost a straight line, and will have thirteen stations, thus making half a mile between each station. The depth is to be from fifty to seventy feet below the surface, and the time taken to run from one end of the line to the other will be half an hour. The capital is £2,700,000, with a borrowing power of £900,000, making a total of £3,600,000, or a cost per mile, equipment and damages included, of £500,000, or \$2,500,000. The diameter of each tunnel is to be eleven feet six inches. Each station is to be supplied with a hydraulic lift or elevator capable of holding one hundred persons, and also a stairway. It is to be purely a local railroad, like the South London Railroad, and is not intended to connect with any other railroad. Its engineer is Mr. James H. Greathead, and it is to be built on what is popularly known as the Greathead system of tunnelling, a description of which you must have read. Its construction will be similar to that of the City & South London Railroad before referred to. I rode through the South London tunnel several times, and, by the aid of a lantern and standing on the rear platform of the last car, inspected the tunnel its whole length. Its average depth is about fifty feet under the surface; each train has three carriages capable of holding thirty-two persons. The cars are modelled after our horse-cars, but much inferior in build and appearance. The service is a six-minute service, the fare twopence, and the time which it takes to run three and one-half miles, including stoppage at six stations, is fifteen minutes, or at the rate of fifteen miles an hour. The noise is like the roaring of the ocean after a storm, and many persons whom I interviewed told me they always experienced a headache for some time after leaving these cars. I must

confess I experienced a similar sensation myself, and though I rode through the tunnel a dozen times I always experienced the same disagreeable results. Hydraulic elevators holding seventy persons take passengers up and down at each station. The tunnel everywhere runs under the streets, with the exception of short distances at either side of the Thames, where it runs under large warehouses ; and, though tested by the most delicate instruments, no subsidence has taken place, nor was any vibration discovered. Approaching each station there is an elevation of one foot in thirty feet for a distance of one hundred and twenty feet. The rest of the tunnel is level. The tunnel is perfectly cylindrical, is built of iron, and is formed of rings twenty inches in length, with flanges four inches deep, each ring being firmly bolted through the flanges. It looks like an enormous boiler laid on the ground. The South London tunnel now in operation is ten feet six inches in diameter. The new tunnel will be eleven feet six inches and have thirteen stations, and will run cars its whole length, seven miles, in half an hour. The system of building the tunnel, as described by Mr. Greathead himself, is as follows : —

The tunnels are of cast iron, and are composed of a number of segments which are built up and bolted together so as to form rings. Those rings are successively bolted together, and in that way a continuous tube is formed of iron. The mode of placing these segments together is this : There is what is called a shield composed of steel plates which is smooth outside and inside, fitting over the forward end of the tunnel, and having in front of the opening a cutting edge, and inside a number of hydraulic presses. These presses press against the forward end of the completed portion of the tunnel, and as the hydraulic pressure is increased in these presses the shield is forced forward, sliding upon the iron tunnel, and cutting out the clay at the front exactly to the outside diameter of the shield. The material that is in that way brought down is brought back through the opening in the front of

the shield, and is carried away through the completed tunnel and up the shafts. Where the shield has been advanced a distance equal to the length of one of the rings, a segment is brought and dropped in position outside the belt and under the cover of the plate. There they are bolted together to the last ring completed. The shield is then ready to press forward again; but before that is done the space that is left by the advance of the shield, which is equal to its thickness, must be filled up. This is done by means of a groating arrangement—a groating-pin, as it is called, which forces semi-fluid, made of lime or cement, through holes left in the rings for that purpose, in such a way as to completely fill up every space behind the ring. In that way all settlement is prevented, and the iron is encased in a shell of cement about an inch in thickness. By that means each shield could tunnel sixteen feet a day, and with six shields at work in different places the progress on the South London tunnel was, in six months, equal to two and a quarter miles of completed tunnel. When they are finished thus they are complete for all time. In order to prevent corrosion the iron is dipped into a composition of tar while it is hot, and that forms a sort of varnish over the whole surface and partly enters into the iron, the coating on the outside of the iron, and protects it completely, while the operation of tarring may be repeated on the inside if necessary. The iron tube is about an inch in thickness. It is also intended on the new underground road to cement the inside part of the tunnel, which will be a protection and will also deaden sound. In building the South London tunnel they encountered water, but by means of compressed air and other appliances the work was done without any great difficulty. The South London tunnels in some places are only two feet apart. The method of ventilation is all produced by the action of the trains. They propel the air before them, and the fresh air follows as a matter of course. The temperature is between fifty and fifty-five degrees. The South

London road was originally built for a cable-road. The motive power is electricity on these roads, and is generated at a depot for the whole line, and is carried by a main conductor through the entire length of the tunnels. The conductor is laid between the rails. In addition to the main conductor there is a working conductor; that is, a naked conductor, from which the locomotives propelling the trains draw their supply as they move along. It is a steel chain resting on glass insulators. Those are placed on the cross-sleepers, and as the locomotives move along they collect the current from the conductor. That conductor extends from the main conductor through the various signal-boxes on the line. The system is a direct-current system with low tension. The conductor forms one side of the circuit, the rails the other, assisted by a copper wire.

The trains on the new road are to be 120 tons in weight, and will be built after the model of the cars on the New York elevated roads. It will require 18 trains to do a three-minute service on this line, and 2,100 electrical horse-power, according to Sir Benjamin Baker. The trains will run at the rate of 15 miles an hour. The number of passengers carried by the South London road for the half-year ending June 30, 1891, was 2,412,343, with a five-minute service and a train of three cars capable of holding 100 persons. This road, too, has found competition in the penny-omnibus lines, and the result has been that they have reduced their fares between certain stations to one penny during certain hours, with pecuniary advantage to themselves; all of which shows that cheap fares are prized as much as speed.

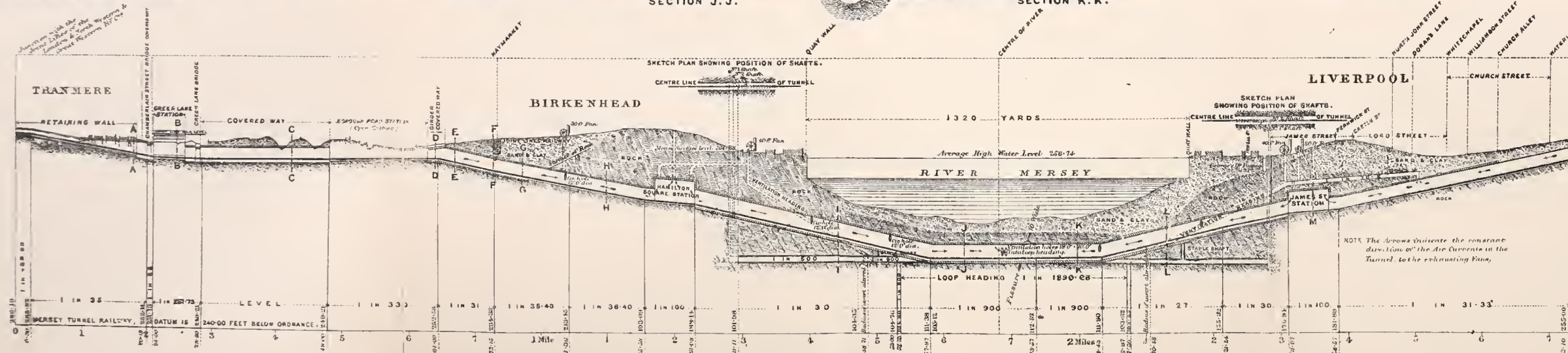
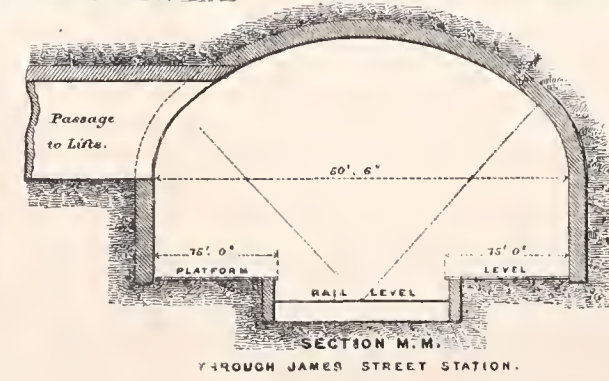
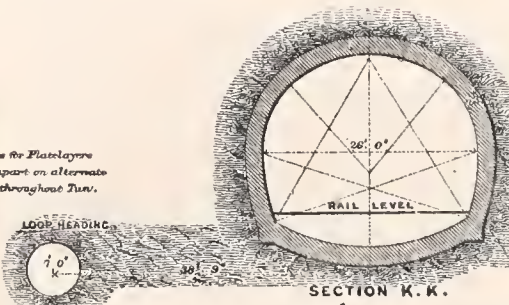
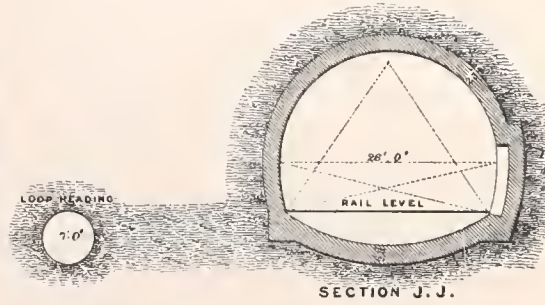
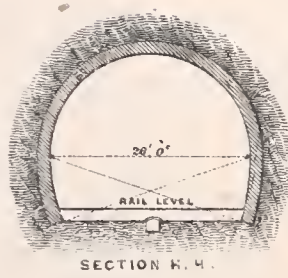
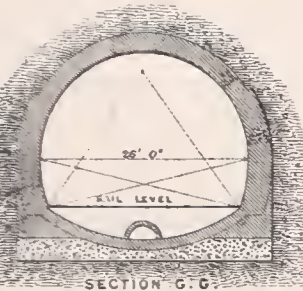
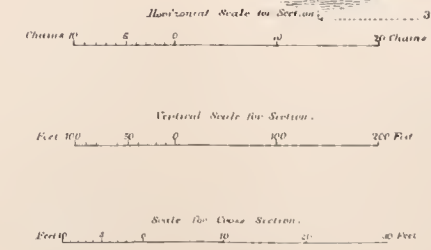
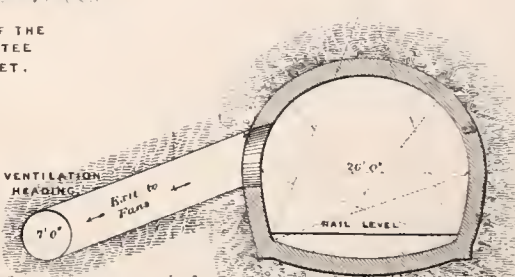
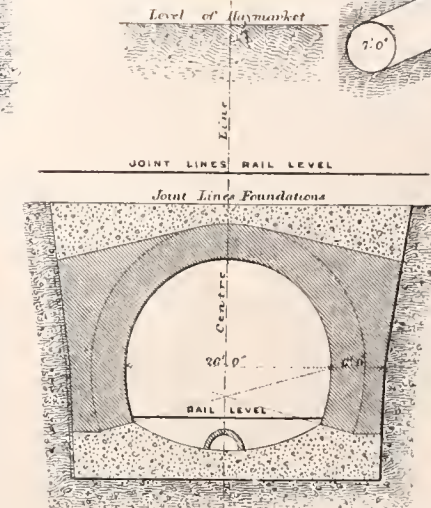
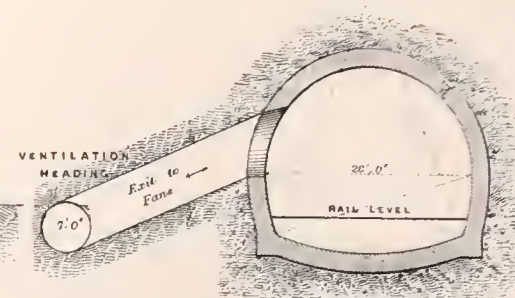
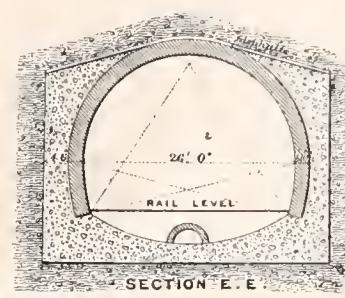
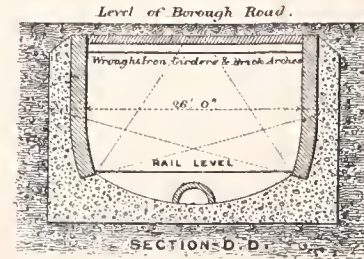
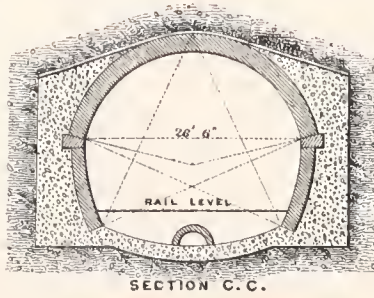
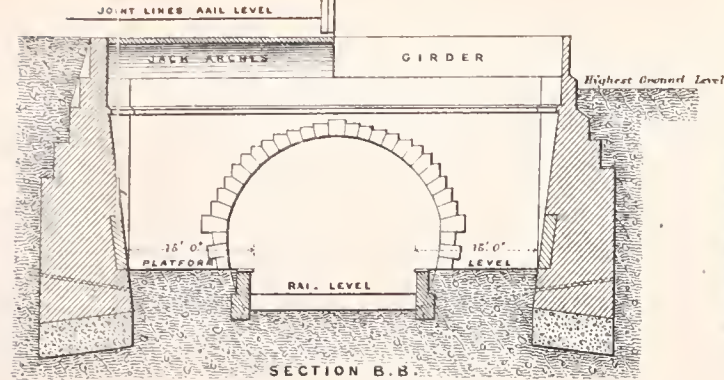
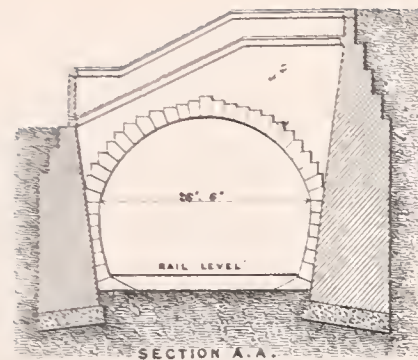
While I am on this subject of tunnels, I wish to describe

THE MERSEY TUNNEL, LIVERPOOL.

One of the most perfectly constructed steam-railroad tunnels is that which runs under the Mersey from Liverpool to Birkenhead, and is 8,000 feet in length from shore to shore. It, like the London underground, was intended to accommo-

date local travel between those towns, but it also has connected itself with the great railroads that run south, east, and west; so that a passenger can take a ticket at the Mersey Building, James street, London, to any part of Wales, and thence to London. Mr. Francis Fox, the engineer of the tunnel, explained to me its construction, and spent nearly two hours in showing me through it and the pumping-stations connected with it. It cost over two million dollars per mile of double track, and it is one of the most perfectly ventilated and perfectly built of tunnels. Mr. Francis Fox was for many years a mining engineer, and simply applied to a horizontal shaft the system of ventilation used in deep mines. There are in reality three tunnels: first, the main tunnel, arched 26 feet wide and 19 feet high, with two tracks capable of accommodating the highest and heaviest coaches; underneath the main tunnel is a water-tunnel, that catches all the water which percolates and would settle on the level of the tunnel; next, there is an air-tunnel 7 feet in diameter, which runs along the main tunnel, and which is connected in the centre by shafts that can, by means of slides, be opened and closed at pleasure. Then at either end of the tunnel are immense pumping-stations, which pump water from the water-tunnel at the rate of 8,000 gallons a minute, and by means of immense wheels or fans, 40 feet in diameter, pump air through the air-tunnel from the centre of the main one. The result of all this is that the tunnel is kept perfectly dry; and next, the foul air being taken from its centre, a current of fresh air is constantly flowing in from either end of the tunnel, and thus the close atmosphere, oftentimes filled with carbon, that one experiences in the London underground roads is entirely absent here. I submit a rough draft of the tunnel, — drawn by Mr. Fox on my note-book, — to give an idea of the Mersey tunnel. I also inspected with him the elevated road now being built along the docks. He is associated with Mr. Greathead in building the road. It is six miles long, built entirely of iron, and its bed is iron-arched,

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like the arched ceiling of a fire-proof room. It will cost £80,000 per mile, and is intended only for passengers who travel along the docks, and connects with no other roads. The Mersey railway, of which this tunnel forms a part, was built with the object of connecting the railway systems on each side of the Mersey, and accomplishes that which a tunnel under the Hudson between New York would in connecting the railroads that run into New York with the great lines that have their terminus on the Jersey side. The tunnel was finished and the road put in operation in 1886. An idea of its depth may be formed from the fact that the water in the Mersey over the tunnel is 100 feet in depth at high tide, and the head of the tunnel 30 feet below. Its declination varies from one foot in 30 feet to one in 900 feet. One admirable feature also is, that the ingoing and outcoming passengers do not pass each other at the stations, as in the elevated roads of New York. The diagram of the Mersey tunnel in this report is worth whole pages which I might write describing it.

PARIS. — ITS RAILROAD FACILITIES.

Paris has no rapid transit worthy the name, and I saw nothing there which would be of much benefit in suggesting a solution of the rapid-transit problem, except that its omnibuses and tramway cars stop at certain stations, which is an excellent feature. Like all the cities in Europe, too, when the passengers' seats are full, no more are admitted, so that everybody is seated; and by means of a ticket beginning with No. 1, and so along, which is given at the station, when a car comes along the person having the lowest number is admitted first, and so from number to number, until the vehicle has its complement of passengers. There is a belt steam-line around Paris twenty-five kilometres in circumference, and which connects with all the lines leading into the city. It is of very little value, because it is too circuitous. What Paris needs, as London does, is a line

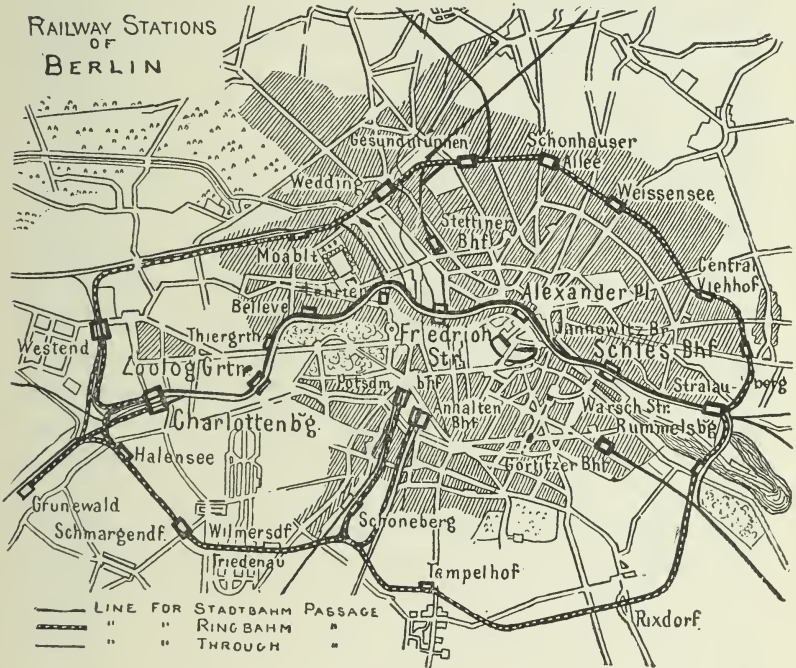
through the heart of the city. But Parisians care more for the beauty of their streets than for rapid transit. The fares are three cents for an outside and six cents for an inside ride on the horse-cars and 'buses. The first enables you to ride a distance of about five miles, and the last entitles you to a transfer ticket. The tramways and omnibus lines are owned by one company, which pays a large tax to the municipality of Paris; but as I have said before, neither in the style of cars nor the accommodation they afford do they come up to the street-railroad cars in the large cities of the United States.

It is in contemplation now to build an underground road in Paris on the Greathead plan, but as yet the work has not begun, but the plan proposes to build it so as to get easily to the business section of the city. I herewith present a railroad map of Paris showing the railroad circle round the city, and the different railroad-stations, with their lines of road.

BERLIN. — ITS ELEVATED VIADUCT.

Of all the railroads which I have seen, and which afford facilities for urban, suburban, and also through traffic, and in whose construction there seemed to be a design to transport travellers by the shortest route from the suburbs to the heart of the city, and through the city also, the elevated railroad of Berlin is unsurpassed. It divides Berlin in halves, from east to west, is about eight miles in length, crosses the Spree three times, and was seemingly built regardless of cost, and made its own highway independent of existing streets, parks, or gardens. It is twenty feet above street levels, has four tracks, and a half-dozen or more handsome stations, about three-quarters of a mile apart, with arched glass roofs, and cost, I am informed, over \$2,000,000 per mile, including land damages. It was built in 1881 by the government, which owns all the railroads in Prussia. This road seems to have solved the rapid-transit

problem for Berlin, for the greater part of the railroads that centre in Berlin run over this road, so that passengers travelling from Paris or Brussels by means of this road can, without leaving one of its stations, go north-east to St. Petersburg, north to Hamburg, and south-east to Vienna or Constantinople, and *vice versa*. It has also tracks for



local and suburban travel, by which people who live on the west side of Berlin, or in the western suburbs, can go to any of the stations in the direction of the east or the suburbs beyond, without change of cars, at intervals varying from five minutes to fifteen minutes, according to the hours of the day or the nature of the day. Sunday is the day of amusement in Berlin. I went to the Frederick-street station to visit the Zoölogical Garden, and see how the

railroad accommodated the immense throng. Trains came along every three minutes, yet it was almost impossible to accommodate the multitude that filled that immense station on their way to the concert in the Garden. With Mr. Hudson, the correspondent of the "Herald," who accompanied me, I rode out to the Garden in a carriage, and there I saw at least 30,000 people, nearly all of whom were transported over this road, for one of its stations is in the Garden. They came from the city and suburbs over this line. I watched in the evening, at the station, their return. The crowds began to leave the Garden about seven, and there was a constant stream of passengers every two or three minutes crowding the long trains, and the cars were as filled as picnic trains with us. There was scarcely standing room. This railroad is a very solid one, built of iron, stone, and brick. I walked along it for over four miles. It never runs through the middle of a street, but very often forms one side of a street. Where that is the case it has a sidewalk along it, and the Roman arches are filled in with hard-pressed, cream-colored brick, with windows like the windows of a Gothic church, presenting a rather pleasing appearance. It is like the first story of a house. I noticed that on the other side were what appeared handsome apartment-houses, as for instance near the Frederick-street station, so that the elevated road did not seem to interfere much with the comfort of the well-to-do citizens of Berlin. The spaces under the viaduct are not much rented except in the vicinity of the stations. In addition to the magnificent road, Berlin has a belt line which circles the city like the belt line in Paris, and connects with every railroad that runs into Berlin. The viaduct extends practically from Charlottenberg in the west to the Schlessischer station in the east. One thing I noticed in travelling over the railroad from Paris to Berlin, especially in German territory, was — that when a railroad entered the town it became an elevated one, all the streets running under it, and that, too, for a long distance,

as in Hanover and Cologne and Aix-la-Chapelle. By means of the viaduct and the ring line around Berlin, its citizens and suburban residents seem to be better supplied with rapid and cheap transit than any other city in the world. Its horse-car and omnibus accommodations, too, are good, though I cannot praise their style; but they run in every direction, and, taken altogether, Berlin seems to have solved the problem of rapid transit. Mr. Hudson, of the "Herald," whom I met by accident in Berlin, and who with me performed four or five hours' pedestrianism in examining the elevated road of Berlin and its stations, and exchanging ideas as to its uses, has so well described this road that I cannot refrain from making his letter to the Boston "Sunday Herald" part of this report, marked Appendix. In addition, I present a railroad map of Berlin, by which the Commission can see at a glance the relation which the viaduct road, the ring road, and the various roads that centre in Berlin bear to each other. I also present herewith, for a more extended description of this important railroad, a book entitled "The Construction of the City Railroad of Berlin." It illustrates admirably and in detail the workmanship of the road, including bridges, arches, stations, architectural and engineering advantages, so that the Commission can, by looking at its numerous illustrated pages, get a fair idea of this celebrated railroad.

CONCLUSION.

Having thus given, in as brief a space as possible, a description of the street-car system of the cities of Europe which I visited, also of the underground, steam, and electric system of London, as well as that of the great viaduct road in Berlin, I will conclude by giving my impressions of these roads, especially the underground roads of London and the elevated road of Berlin.

In connection with the street-cars, the cheap fare for short-distance travel impressed me very much, and the

testimony of those connected with street-car management invariably was, that it increased travel and benefited both the public and the railroad corporations. The ordinance, too, in prohibiting the loading and unloading of heavy teams in the business streets of London during certain hours of the day, has much to do with the smoothness by which travel is facilitated, notwithstanding the enormous number of omnibuses and cabs that move in an unbroken procession along the streets of London. If a like ordinance were in operation here, and applied to Washington and Tremont streets, much of the congestion which now prevails would be lessened. Who has not experienced the frequent delays that occur on the streets mentioned, by the unloading of safes, coal, and flagstones, and the keen delight which often beams on the faces of the drivers of these heavy teams, feeling that they can retaliate on the horse-car conductor and driver for being so often obliged to leave the track? Slow and heavy teams are seldom seen on the crowded thoroughfares of London.

The electric underground railroad of London, I must confess, though it be treason perhaps to say so, did not impress me favorably as a passenger travelling along it, and that impression was shared by nearly every person to whom I spoke in my desire to get the ordinary passengers' views about it. I went to London to inspect it, and, with a partiality rather in its favor, I rode through it a dozen times or more. By the courtesy of the officers I inspected it from a rear platform by the aid of a lamp, and the oftener I travelled over the road the less favorably it impressed me as a system for Boston. I found that the air is fresh enough in the tunnel, with a temperature of fifty degrees; that the cars are invariably closely shut to exclude the great draught, and the air in them is not good. This keeping of windows and doors closed is necessitated by the great draught which the single-track tunnel has. Then, in addition, there is a noise like the roaring of the ocean mingling with that which electric cars usually give, making the short trip of one-

quarter of an hour a very disagreeable one indeed. I asked the engineer if it were possible to do away with the sound. He answered, of course, no; but it could be lessened by lining the tunnel with some substance that absorbs sound. If such a tunnel were built in Boston the temperature in it, I am informed by our engineer, would be fifty degrees — not a very inviting place for delicate persons on a summer's day, with the thermometer outside in the nineties.

As a piece of engineering I presume it is perfection, but as a mode of conveying human beings from one part of a great city to another I should much prefer some other method, and some other feeling when travelling than the buried-alive feeling which one experiences in this tunnel. The underground District railroad of London is entirely different. To be sure, the odor of gas is sometimes around, but a gleam of light comes in every few minutes. It is double-tracked, leaving plenty of space for air. It has open spaces wherever they can be got. It is near the surface, the temperature of the tunnel is about the same as that of the outside air, there is no intense wave-sound, and one feels in riding through it much more comfortable than when travelling through the tunnel of the New York & New Haven road in the city of New York. One great feature of this road, too, is that it affords its patrons the opportunity of connecting with nearly all the great railroads that go out of London. In addition, it enables a person living ten or more miles in an eastern suburb of London to travel to any part of London in a westerly direction, or to a western suburb ten miles outside, without change of cars. What this underground system does for London, the viaduct system of Berlin does more completely for that city. By how much light is above darkness for a traveller, in the same measure is the railroad viaduct of Berlin above and beyond any of the other modes of conveyance which I have seen. But its perfection is not alone in its workmanship and its elegant stations and the fact that it is in the sunshine; but it con-

sists also in the facilities it affords for travelling in any direction east and west, and to any part of Europe, without leaving the line of this road, thus not only giving the citizens of Berlin easy, cheap, and rapid transit, but forming a direct line of communication between the great railroads of the German Empire. If Boston had such a road, the people who live in its northern suburbs or in northern New England would come from their respective homes to one central station on the north side of Boston, and travel over this viaduct road, which would have three or four stations in the city and near the business streets, and would connect at a central station on the south side with the southerly roads, and could go to any southern or western suburb, or farther south or west, thus avoiding the necessity of buying tickets two or three times, of changing baggage, or of travelling across the town. The German Empire built the road I have described. I am much afraid no private corporation could afford to build such a road here, but if built, no matter by whom, nobody will deny that it would be of inestimable advantage to the people of Boston and its suburbs, and would solve a great part of the rapid-transit question with which we have to deal. I refrain from saying anything further in relation to the needs of the city and suburbs, as that would be forestalling the action of the Commission of which I am a member; for I feel sure whatever will be recommended will not be a mere temporary expedient, but something that will be for the future too, and that will benefit every section of the city and every suburb around it.

With an increase of steam-railroad travel in and out of the city from 20,000,000 in 1881 to 51,000,000 in 1891, an increase of horse-car travel for the same period from 49,000,000 to 114,000,000, with an increase in population in Boston and its suburbs for the same period from 450,000 to 860,000, with the enormous increase of travel in our public streets, especially Washington and Tremont streets from Boylston to Court streets, — great as that of any street

in London, Paris, or Berlin, — something should be done, not for to-day alone, but for the greater Boston of the future. With this report, and making part of it, I submit: —

“The Tramway Act of 1870 for Great Britain.”

The returns of all street and road tramways in Great Britain and Ireland down to June 30, 1888, giving the gross receipts, net receipts, working expenditures, number of passengers conveyed, and number of miles of road operated.

A full description of the City and South London Railway (underground electric); also the report of the directors of the road for the half-year ending June 30, 1891.

The last yearly report of the Metropolitan District Railroad of London, together with a map of the same, and its time-table.

The act of Parliament, 1891, Vic., chap. 54 and 55, incorporating “The Central London Railway Company” to construct underground railways from Shepherd’s Bush to the city of London, together with a printed report of the parliamentary hearings on the subject, containing the evidence of Mr. James Greathead and other eminent engineers on underground and electric railroads, which I obtained with great difficulty, through the efforts of a member of Parliament.

I also submit a pamphlet giving a full and illustrated description of the Mersey tunnel, together with various charts and maps of London, Paris, and Berlin, with their railroads.

JOHN E. FITZGERALD,

Rapid Transit Commissioner.

APPENDIX.

BERLIN'S CITY RAILWAY.

ITS VIADUCT FOUR-TRACK SYSTEM, AND HOW IT IS OPERATED.

FIVE HUNDRED TRAINS A DAY, FIVE-MILE RIDE FOR TWO AND ONE-HALF CENTS, THE STATIONS AND EXCELLENT METHOD OF HANDLING TRAFFIC, NO CONFUSION, SPACES UNDER THE ARCHES USED FOR SHOPS, RESTAURANTS, ETC.

(Special Correspondent to "Boston Herald.")

BERLIN, September 12, 1891.

I confess to feeling a certain surprise that, having come to Berlin to procure for the readers of the "Herald" some information concerning its internal railway facilities, I should on a previous visit have learned so little in regard to the Berlin Stadtbahn, which is undoubtedly the most extensive and costly, as well as the most useful, city railroad in the world. It performs for Berlin the same service which the Metropolitan underground railroad does for London (and vastly more), and it does the business in a much more satisfactory way.

The more I have studied the relations of this railroad to the growth of Berlin, and to the other railway systems which centre here, the more interesting and suggestive the Stadtbahn has seemed to me.

I cannot help believing that if all the people in Boston could live for three months in Berlin they would speedily resolve to have a Stadtbahn of their own.

I will endeavor, with the aid of a series of photographs, to give the "Herald" readers as clear an idea of this remarkable railway line and the work which it does for the German metropolis as can be obtained without taking up one's residence here.

I shall best begin my account of the great viaduct four-track railway in Berlin if I indicate what an equivalent structure and service would do for the city of Boston.

This great viaduct in Berlin passes through the very heart of the town, as I have somewhat briefly described in a previous letter.

Now let us suppose that all the railroads that enter the city of Boston came in on elevated ways. Suppose that all the northern lines except the Fitchburg were brought together in one elevated station on the north or south bank of the Charles river on the north side of the city.

Then suppose that this station, instead of being a terminal station, was open at both ends, and from its southern end a viaduct wide enough to carry four tracks was built around the city by the banks of the Charles river to the nearest point to the entrance of Charles street, between the Common and the Public Garden. Then imagine this viaduct continued over Charles street, between the Common and Public Garden, to Park square.

Then suppose the Boston & Albany and Old Colony lines to be bunched on a single elevated line somewhere south of the Park-square station. It would then be possible for trains to be run through without breaking from the Eastern, Boston & Maine, and Lowell lines to Providence, New York, Newport, and all other points on the southern lines, and *vice versa* from southern points to Portsmouth, Portland, Lowell, and Concord on the northern lines. This would occupy two of the tracks on the viaduct railway.

Then suppose, further, that a certain number of trains ran back and forth from the northern elevated station to Park square, or, perhaps, some station farther out in Roxbury.

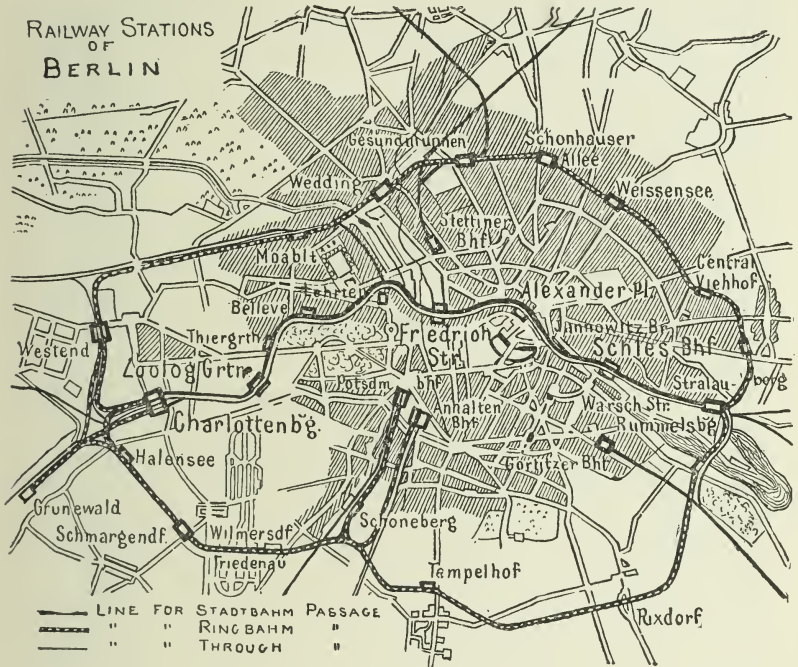
Again, suppose that another set of trains started from the northern station and ran through the city, out over the Boston & Albany line to the Grand Junction railway, and around to the northern station, making the circuit; the same number of trains to be run in the opposite direction.

One more set of trains remains to be named; viz., trains to run from Lynn and other suburban cities on the north side as far as

Quincy, Dedham, and the Newtons on the south and west, and *vice versa*.

If Boston had such a railway service as this, it would have something resembling what Berlin has in its "Stadtbahn."

The accompanying map should be carefully studied by any person desiring to understand the railway system of Berlin.



It may be described as follows:—

The Stadtbahn, with thirteen stations:—

- | | |
|------------------------------|-------------------------------|
| 1. West End station. | 8. Boerse station. |
| 2. Charlottenberg. | 9. Alexander Platz station. |
| 3. Zoölogical Garden. | 10. Jannowitz Bridge station. |
| 4. Thiergarten station. | 11. Schlessischer station. |
| 5. Bellevue station. | 12. Warsaw station. |
| 6. Lehrter station. | 13. Stralau station. |
| 7. Friedrichstrasse station. | |

The Ringbahn, with 16 stations : —

- | | |
|-----------------------------|----------------------------|
| 13. Stralau station. | 21. West End station. |
| 14. Friedrichsberg station. | 22. Halensee station. |
| 15. Central Cattle station. | 23. Schmargendorf station. |
| 16. Weissensee station. | 24. Wilmersdorf station. |
| 17. Schonhauser station. | 25. Schoneberg station. |
| 18. Mineral Water station. | 26. Tempelhof station. |
| 19. Wedding station. | 27. Rixdorf station. |
| 20. Moabit station. | 28. Treptow station. |

Five great terminal stations independent of the Ringbahn and Stadtbahn : —

1. Anhalt station on the Ascanisher platz, for Dresden, Prague, Vienna, Leipsic, Halle, Thuringia, and Frankfort-on-the-Main.

2. Potsdam station, Potsdamer platz, for Potsdam, Magdeburg, The Harz, the lower Rhine, Cassel, Frankfort, Coblenz, Treves, and Metz.

3. Stettin station, Invaliden strasse, for Copenhagen, Stockholm, Stettin, and Dantsic.

4. Gorlitz station, Wiener strasse, for the Spreewold, Cottbus, Gorlitz, and the Giant mountains.

5. Lehrte or Hanoverian station, near the Alsenbrücke, for Hanover, Cologne, Paris, Bremen, Hamburg, Mecklenburg, and Holstein.

It would obviously not be possible to convey the passenger traffic of a city of a million and a half of people through one station or set of stations. Stadtbahn was primarily intended to relieve the streets of Berlin, but it was found possible to utilize it for general traffic, and I find on investigation that while on the northern pair of tracks there are handled every day 320 purely local trains, the other pair of tracks afford facilities for 166 trains going to or arriving from places outside the city of Berlin. Here is a total train-service of 486 trains each day, to all of which access may be had from a number of stations in the heart of Berlin. Let us now pay a visit to the Friedrichstrasse station, which is located at the most central point on the line, and from which more people depart every day than from any other station.

The large picture of the Friedrichstrasse station could be improved. We look right through the station and see how it is built. The walls are not straight because the line curves sharply

at this point; but this does not injure the appearance of the structure, which shows a careful attention to details in the exterior design. With so much glass at both ends, it was unnecessary to insert glass in the roof, which is of metal, and shows almost a full circular curve in its elevation.

The fine quality of the brickwork of the viaduct and the elaborate ornamentation of the façades under the arches come out strongly in this picture. It should be said that while the viaduct touches the wall of a private building on the north side (east side of Friedrichstrasse), its southern side here faces on a broad and well-paved street, upon which have been built up within the past ten years as handsome five-story structures as can be found in Berlin.

If we now buy a ticket (for two and one-half cents) to some point on the line, and ascend to the train platform, we stop there as long as we like and witness the operations of the service. Selecting an hour in the day when there was no especial rush of passengers, I counted the number of passengers who entered during five minutes, and found it to be a little short of 100. During the following five minutes I counted the number of departures. An eastward train deposited 25 passengers and a westward train 45. Now take a look at the time-table of the line. Here are —

118 trains, running through the Friedrichstrasse station at intervals of 10 minutes from Charlottenberg to the Schleswig station between the hours of 5 A.M. and 12 P.M.; 37 of these trains come into Charlottenberg from Potsdam; 87 go on to points beyond the Schleswig station.

118 trains, same service, in opposite direction.

19 trains, coming from Charlottenberg, pass through the Friedrichstrasse station, and go on to Treptow and points beyond.

19 trains, same service, in opposite direction.

14 trains from West End to Gruenwald.

14 trains, same service, in opposite direction.

9 trains from the Schleswig station between 4:06 A.M. and 5:11 A.M. in the direction of Stralau, Rummelsberg, and the Nording.

9 trains, same service, in the opposite direction.

320 trains on local tracks.

- 14 trains from the Potsdam station by the South Ring to Gruenwald.
- 14 trains, same service, in opposite direction.
- 42 trains from Charlottenberg through the Friedrichstrasse station to Stralau Rummelsberg.
- 42 trains, same service, in opposite direction.
- 14 trains from Charlottenberg eastward through the Friedrichstrasse to Frankfort-on-the-Oder. Seven of these go to Breslau and one goes through to Constantinople.
- 14 trains, same service, in opposite direction.
- 8 trains from Charlottenberg through the Friedrichstrasse to Kœnz, Bromberg, and Kœnigsberg.
- 8 trains, same service, in opposite direction.
- 5 trains from Charlottenberg through the Friedrichstrasse to Goelitz.
- 5 trains, same service, in opposite direction.
- 4 trains from Schleswig station westward through the Friedrichstrasse to Stendal and Hanover. Two of these go through to Paris.
- 4 trains, same service, in opposite direction.
- 3 trains from the Schleswig station westward through the Friedrichstrasse to Potsdam and Magdeburg, making connection through to Paris.
- 3 trains, same service, in opposite direction.
- 3 trains from Schleswig station through the Friedrichstrasse to Nordhausen. Two of these go to Frankfort-on-the-Main and one to Metz.
- 3 trains, same service, in the opposite direction.
- 4 trains from Schleswig station through the Friedrichstrasse to Erkner, etc.
- 4 trains, same service, in the opposite direction.

166 trains through service.

The second picture of the Friedrichstrasse station, showing the curved southern façade, almost tells its own story. Here are the entrances for passengers going to or coming from places outside of Berlin, and a vast tide of travel flows through these portals every day. Here are the passengers' waiting-rooms, the ticket-offices, the baggage-rooms, and all accessories of a great railway station. Huge hydraulic elevators lift the trunks and boxes of

the travelling public to the level of the trains overhead, and the German post-office department requires a great deal of space, for much of the Berlin matter is handled at the Friedrichstrasse.

I counted nine windows in a row at which tickets are sold to the through passengers at this station, which will give you an idea of the provision which is made for accommodating the public here. The entrance for local passengers is on the north side of the station from the Friedrichstrasse, and here there are only two or three windows for the sale of tickets, which is not enough to accommodate the crowds that flock there. Still there is less time consumed in giving change, more tickets are sold to one person than on the through line. When Mr. Fitzgerald and I went there on Sunday morning, we found the entrance clogged with people, and were told that the sale of tickets had been temporarily suspended because more people had accumulated on the platform above than the trains could carry, for the time being. This delay, of course, lasted only a short time.

The Stadtbahn is about eight miles in length, — five miles being a viaduct of brick arches and one mile of iron trestle-work. The railway crosses the Spree three times, and the canals that connect with the Spree, a good many more times. There are no less than sixty-six bridges over streets and watercourses. One mile of the road was built on the filled-in bed of the old city moat. Part of the line is built on arches rising directly from the river-bed. At different points a great many buildings had to be pulled down to make way for the viaduct.

Let us go over the line, starting at the Schlessischer station, where the viaduct begins, in the eastern section of the city. The viaduct is built to the next station, at the Jannowitz bridge, partly through territory that was entirely covered with buildings, and partly in the river-bed. It penetrates two solidly built-up blocks, passing to the rear of the buildings on Breslauer street, then crosses Holzmarkt street and strikes the river. At this point are the great wood, brick, and stone yards of the city, and many of the arches between the Schleswig station and the river are left open, and are used as a part of these great wood and brick yards. The great English gas-establishment of Berlin is also near the line where it touches the river. After crossing the Jannowitz bridge the road curves to the right and follows the line of the old moat, and

here there was an opportunity to create a wide street on each side of the viaduct.

Then we come to the Alexander Platz station, which is a sort of grand central station for north-eastern Berlin. Adjacent to this is the great central market of Berlin, the vastest place of the sort I have ever seen. Here the Stadtbahn is only four or five minutes' walk from the Rathhaus, or City Hall, the principal post-office, the Emperor's residence, and many of the most important buildings in the city. The central police-building, which really seems to me the most enormous structure in all Berlin, is very near the Alexander Platz station.

After leaving the station the line makes a great bend to the left, still passing through "old Berlin," and presently we come to the Bourse station, so called because the Berlin Stock Exchange is the nearest building of importance. At this station we come very near to the "Dom," as the Royal Lutheran Church is called, and the grand art museum of Berlin. Then, crossing two streets where there is an immense tide of travel, the viaduct penetrates a solid block of buildings, crosses the Spree directly in the rear of the National Gallery, and passes through an old quarter of the city to the Friedrichstrasse.

A handsomely built-up street runs along the viaduct here on its southern side, and at this point the railway is parallel to Unter den Linden and very near it. Then we go over the Spree again, and the line curves around to the right, making a *détour* in order to pass at the rear of the great Lehrte terminal station and to pass through the grounds of the exhibition buildings, where each year Berlin has some sort of a great show, which hundreds of thousands of the people visit. This year it has been the International Art Exhibitions, and there is a passage from the Stadtbahn station at this point directly to the exhibition buildings.

Then the line continues to the south-west, the viaduct closing the left side of a great street, Luneberger street, upon which is as handsome a continuous line of five-story buildings as can be found in the city.

We next made another diagonal passage over the Spree, and bring up at the Bellevue station. Here is another curve, and the line turns to the southward, going through blocks of buildings and along the sides of streets until we come to the station at the side of the Thiergarten, Berlin's principal city park. The viaduct

really does not extend for a great distance through the park, as we soon come to Hippodrome, and then to the Zoölogical Garden, the great popular resort for the average Berliner, especially the women and the young people of both sexes. In this great establishment from 50,000 to 100,000 people frequently gather on a single afternoon, and on every pleasant day there are not less than 15,000 there to listen to the two military bands, which discourse as good music as Germany affords. Of course, such crowds could not readily gather and disperse without the Stadtbahn.

The picture of the Alexander Platz station printed herewith gives a very good view of the most important stations on the Stadtbahn line. It is in the heart of old Berlin, and not far from the Rathhaus. It stands close to Königstrasse, a great thoroughfare leading down to the Emperor's castle. Its architecture is more ornate than that of most of the stations. A very good view of the elevated structure that spans the street is obtained at the left. This station is especially remarkable because it adjoins the great Central market of Berlin, and the supplies for this market are brought in from the country on the Stadtbahn. In another letter I shall give you a fuller account of the manner in which the market supplies of central Berlin are handled at the Alexander Platz station.

The Stadtbahn's cost was 70,000,000 marks, nearly \$18,000,000, and of course was not intended to pay dividends. The enterprise was begun with a capital of 16,000,000 thalers (a thaler is about seventy-five cents), of which the government contributed 7,000,000, or nearly one-half; the German Railway Construction Company, engaged in developing the suburbs of Berlin, 4,000,000; three of the great railway lines, 5,000,000. In 1872 the German government appropriated 120,000,000 marks to be used in building railways for strategical purposes, and it is admitted that the object of the government in making this appropriation of nearly \$6,000,000 was to enable troops to be despatched with great rapidity to and from and through the city of Berlin. Now, with the aid of the Ringbahn, there may be said to be three connecting lines by which armies gathered from the country north and east of Berlin could be carried through the city, without leaving their railway trains, and despatched Franceward. The limit to the transportation facilities would not be the railway system of Berlin, but the capacity of the main line. A whole army corps

could be moved through the heart of Berlin in a single night, and the inhabitants of the city know nothing about it.

But whatever interest the State may have had in the matter, it is evident to any one who spends a day upon the Stadtbahn that it plays a tremendous part in the life of Berlin. Here are nearly 500 trains going to and fro on this great four-track railway above the streets and canals of the city. Each train consists of at least eight coaches, with five compartments providing seats for eight persons in each compartment. Most of the time from twelve to fifteen persons crowd into each compartment, and at the Friedrichstrasse station I observed that there is a scramble for places in nearly every train. Thus, instead of carrying 300 passengers, many of the 274 local trains that pass daily through the Friedrichstrasse station probably carry 1,000. The 166 trains that we should call "through trains" running on the other two tracks may easily average 500 passengers each. Here, therefore, is a carrying capacity of over 350,000 for each day in the year, and the number of trains could be so increased as to make the number at least 500,000. I shall endeavor to obtain from the authorities definite statistics in regard to the actual number of passengers carried each day, but it can hardly fall short of 250,000.

The construction of the viaduct seems to have been everywhere most thoroughly done. Wherever I have entered the spaces under the arches that are used for shops, warehouses, or for other purposes, I have found them dry and clean. It is interesting to observe that the tracks are laid on wooden ties and ballasted with broken stone and sand, the same as on any first-class surface railroad. The drainage of the tracks seems to have been very well managed. None of the bridges over streets require underlining to protect passers from dripping water or falling objects from above. Through the central portions of the city yellow brick were used in the construction of the viaduct, and wherever there are streets and houses facing the viaduct some effort has been made to decorate the exterior. Red brick were used where the viaduct arches rest in the waters of the Spree, and also through the parks.

Mr. Commissioner Fitzgerald and myself, in going along the line, paid careful attention to the use that is made of the space under the arches, and we saw that much of it is not used. But I should say, on an inspection of the whole line, that more than half of it, where the arches rest on the ground, is put to some use.

Between the Friedrichstrasse and Bourse stations I saw several good shops, used as restaurants, cigar-stores, etc. The arches are very thin at the centre, and every train that passes makes a heavy rumbling sound underneath it. At the exhibition grounds several of the arches are fitted up as one of the most elegant restaurants in the city. No doubt use will be found in time for all the available space under the viaduct. Herewith is given a front view of one of the arches near the Friedrichstrasse station, which is very finely decorated, and which must bring a very handsome rental on account of its central location.

The system of transportation on the Stadtbahn provides for making some stations purely local, and these stations are small ones, inexpensively built. The Jannowitz bridge station, of which I had two views, is one of the local stations. It is merely two glass walls and a metal roof, enclosing two of the four tracks, to protect passengers from the weather.

From this bridge little excursion-steamers run up and down the Spree. There is a large amount of travel over the bridge, which is, in fact, one of the thoroughfares of Berlin. The junction of street, river, and railroad makes it a very lively place and an interesting one to visit. The pictures show that abundant use is here made of the available space underneath the viaduct.

The method of handling the passenger traffic at all the stations is the same. There is a fixed rate of ten pfennigs, or two and one-half cents, for a trip upon the Stadtbahn from any station to any station between the Schlessischer station and Charlottenberg. From stations on the Stadtbahn to stations on the Ringbahn the fare is five cents. Here, you see, is a rate of half a cent a mile. At the stations called halt stations, where only the local-passenger tracks are used, — namely, the Jannowitz bridge, Bourse, Lehrte, Bellevue, and Thiergarten, — a broad stairway leads up from the ticket-offices and waiting-rooms below to a broad asphalted platform in the centre of the station. The tracks are next to the walls of the building on each side. No effort is made to separate the passengers going eastward from those bound in the opposite direction. Two uniformed guards stand at the top of the stairs, and require all passengers coming up to show their tickets, which are then punched. The stairway is usually divided by a railing into two sections, — sometimes there is only a pillar at the top, — and passengers going up are directed by numerous signs to keep to the

right. Arriving passengers use the other half of the stairway in descending, and the guards take up their tickets as they go down.

It might be supposed that this system would lead to a good deal of crowding on the stairs, but it does not seem to give any trouble, and the confusion of having separate entrances and exits is avoided. I do not see that there is anything to prevent a passenger, arriving with a crowd of others at a station, from stepping across the platform and jumping into a train going in the opposite direction. But no protection is needed here, for everybody who buys a ticket is going somewhere, and nobody wants to spend any time merely in riding up and down the line. Besides, if the vigilant guards should catch any one doing this, there would be a little fine of six marks to pay at once, that being the penalty for riding upon the Stadtbahn without a ticket.

Tickets are sold in any number desired, and are good for the whole year. But, of course, there is no reduction in the rate when a large number of tickets is purchased, and no mileage books are sold. Two and a half cents is a low enough rate for a five-mile ride, even in this land of low prices.

It will be seen that the system of despatching and unloading the passengers is the simplest possible, and in this case the simplest is undoubtedly the best.

There is no confusion in regard to the trains. One of the station guards has for his duty to put up a sign for each train at the moment its predecessor leaves the station, which sign tells where it is going. A westward train from the Friedrichstrasse may be going only to Charlottenberg, or it may be going on to West End, or it may be going to make the circuit on the North Ring, or it may be going to the South Ring.

When you ascend the stairs to the platform, the first things you see are the signs telling where the next trains on both tracks are going. If you are going to West End, and the west sign says Charlottenberg, you must sit down on one of the fixed wooden seats that are provided, and wait until the next train comes along, which will surely accommodate you. There are toilet-rooms for both men and women on the platforms of most of the stations, and the comfort of the public is abundantly provided for.

EDMUND HUDSON.

REPORT

ON THE

Transportation of Passengers in and
around the Cities of Europe,

MADE BY

OSBORNE HOWES, JR.,

TO THE RAPID TRANSIT COMMISSION OF THE STATE OF
MASSACHUSETTS AND THE CITY OF BOSTON,
NOVEMBER 10, 1891.

R E P O R T

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Gentlemen of the Commission: —

In making a report on some of the systems of passenger transportation in use in several of the large cities of Europe, it seems desirable, for the sake of clearness, to classify these by their general characteristics, rather than by their geographical locations. The following is the order taken: —

First. Street-cars, and the conditions controlling their operations.

Second. Underground roads.

Third. Elevated roads.

Fourth. Terminal facilities of steam railroads.

Fifth. Rates of fare, zone system of charges, and general effect of better methods of transportation in encouraging suburban travel.

Sixth. Street widenings.

STREET-CARS.

It may be laid down as a rule, having few if any exceptions, that in the franchises granted to street-railway companies in the cities of England and of the continent of

Europe, the government, either national or municipal, reserves to itself the right to fix the rates of fare and the number of trips which shall be run during the day and night ; to decide the form of track that shall be used, and the part which the companies shall pay of the expense of paving, cleaning, and watering the streets through which the tracks run ; and, finally, to purchase the entire plant, either at any time, or at the end of a fixed period. In other words, many of the rights which the American municipalities have surrendered to street-railway companies, the municipalities of the Old World have jealously retained.

LIVERPOOL TRAMWAYS.

The street tracks in Liverpool are all owned by the municipal corporation, which some years ago purchased and reconstructed the then existing lines, and which has since considerably extended them. It has now the ownership of about fifty miles of single-track road, all of which is leased to the Liverpool United Tramways and Omnibus Company (limited) for a term of twenty-five years, on a payment of approximately ten per cent. per annum on the cost of construction, which for the purposes of the lease is arbitrarily fixed at \$30,000 per mile, as this is estimated to be a fair average. By the terms of this agreement the city agrees to keep the tracks in order, leaving to the tramways company the sole duty of moving the cars. This lease terminates in 1894, — for all of the newly constructed track is included under it, — and as by means of it, it has been possible for the tramways company to pay considerable annual dividends upon a capital largely increased by the issue of watered stock, there is a strong popular demand that the city government shall take and administer this business as one of the municipal functions.

The money now received in the form of rent is devoted, first, to meeting the demands of the sinking-fund, created to pay the debt incurred in purchasing and building the track-

ways; second, to paying the expenses of keeping the tracks in repair and the trackways in good condition; and what is left over is divided among the several districts of the city of Liverpool, in proportion to the track mileage within each district, as so much to be deducted from the taxes which the ratepayers contribute to pay for the expenses of street maintenance.

Possibly, in view of the short time the present lease has to run, and the doubts which have been expressed as to its renewal, the tramways company feels under no obligation to keep its service up to a high point of comfort and efficiency. Certainly its cars are not particularly clean or otherwise inviting in appearance. They are all of the double-decked structure, as are practically all of the tram-cars on the English lines, and usually have a carrying capacity of eighteen inside and the same number outside.

The usual fare is 2d. (four cents), inside or outside, though during a part of the day 3d. (six cents) is charged on some of the lines. The omnibuses, which in certain instances run in competition with the tram-cars, charge, as a rate of fare, 1d. (two cents). The speed of the cars is no greater than the schedule speed of the West End cars; but as they do not run through streets greatly crowded with wheeled vehicles of all kinds, their progress is not delayed at any part of their route, as is the case with our system. This result is attained by restricting the number of the lines, for, as indicated by the mileage given above, the lines are none of them what we would consider suburban lines, while there are certain business parts of the city that are entirely unsupplied with tramway facilities; and, again, in the plan of routes, care has been taken, in all but very broad streets, to have but one line of tracks, so that cars on their homeward journey pursue a different, but parallel, route from that taken by them on their outward trips. At places where large numbers of passengers ordinarily take the cars the line of the tracks—usually in the middle of the street—is

deflected so as to bring the cars close to the curb of the sidewalk.

This change in the location of the tracks can be made without inconvenience in Liverpool, because of the unobstructive character of the track itself, and the equally unobstructive manner in which it is put down. The upper contour of these tracks resembles the letter U. The bearing rim or surface for the wheel is small, as is also, both in width and depth, the indentation in which the flange of the wheel runs. These tracks are laid so that no part of them rises above the surface of the street. They are put down in a manner which ties the track and the immediate surface of the street together; and while all kinds of vehicles can cross over them at any angle, with hardly any jar or strain, it is asserted that but comparatively little difficulty is experienced in winter in freeing the tracks from ice and snow, though there is, of course, less of these obstructions to contend with than are met with during an average winter in Boston.

In the opinion of the city surveyor of Liverpool, who has immediate charge of tramway construction matters, there is no present probability of the introduction there of electric or cable lines. While the people may not be wholly satisfied with the street transit facilities now furnished, the city government would seriously oppose any project which led to the tearing up of the pavements in the principal streets, as would be necessary to put down a cable or electric wire conduit, for overhead wires would not be permitted. These pavements have been put down in a careful manner, at an expense of about five dollars per square yard; and in the judgment of the surveyor, if the surface was disturbed, for the purpose of laying new tracks, or a conduit, it would be necessary to repave the entire street from curb to curb in order to obtain complete uniformity of surface.

I may add, by way of note, that this Liverpool opinion, that when a street surface is in part disturbed it is necessary, in order to obtain an equally good pavement in the future,

to repave the entire surface, is not shared by those having charge of street work in Manchester and Birmingham.

MANCHESTER TRAMWAYS.

There are within the corporate limits of Manchester about fifty miles of street-railway track. This has been built by the city, which began the work of construction some fifteen years ago. In 1877 these tracks were leased to the company which now operates them for a term of twenty-one years, the lease to cover all new construction which might subsequently be undertaken. The first lines of track laid were leased at ten per cent. on an estimated cost of \$50,000 per mile of single track. This it may be assumed was an arbitrary amount, considerably in excess of cost named, because the routes first established were those running through the centre of the city, and hence specially profitable ones. The extensions which have since been made, and which have been covered by the general lease, have been less productive in returns to the municipal treasury, the return received on an assumed ten per cent. of cost rental varying from \$1,500 to \$2,250 per annum per single mile of track. The municipal government decides when and where the tracks shall be laid, and although it cannot force the company, which has generally leased these, to take a new line of tracks, an agreement on this head is generally reached before the work of new construction is begun. It is this that, no doubt, accounts for the different rates at which parts of the lease have been made, as the actual cost of new construction, as given by the city surveyor, is \$12,500 per mile of single track, this including the replacement of the pavement for eighteen inches on either side outside the track. The city receives for its fifty miles of single track, approximately, \$100,000 per annum; but it is compelled to keep the streets and tracks in serviceable condition, and to remove the snow and ice in winter, though this latter service was not contemplated by the city when the lease was made.

The fares are based upon a sliding scale, graded by distance travelled, and run from 1d. to 6d. (2 cents to 12 cents), the latter applying to the longest route, which covers a distance of about six miles. The great majority of the fares collected are 1d. and 2d. fares. This method of grading fares, which has recently been adopted, is said to be satisfactory to the people and profitable to the company.

By the terms of the lease the company is left free to determine the number and time of running its cars. City ordinance restricts the number of persons carried in or on a car to its seating capacity, — that is, eighteen persons inside and twenty on top, — and the company would be heavily fined if the law was persistently violated; but in spite of the law and the risk incurred in ignoring it, in stormy weather and under certain conditions — excursions into the country, for example — it is not infrequently violated. But it is assumed that if the number that a single car can carry is restricted, the dictates of self-interest will force the company to put on a sufficient number of cars and run a sufficient number of trips to earn the largest possible income.

In laying out the routes the city authorities have endeavored to have but one line of track in a street; that is, to have the cars go and return on different streets. In the centre of the city, toward which all of the lines converge, are broad thoroughfares, — Market street and Piccadilly, — and here there are three lines of track, which interfere but little with the ordinary street traffic.

The average speed of the cars is from five to six miles per hour. The cars themselves are, in the main, clean and attractive in appearance. In those hours of the day when the street traffic is greatest, the car-drivers are compelled by city ordinance to keep a distance of about one hundred feet between each car, to avoid street blockades.

The men in the employ of the company have to work for twelve hours per day, at times most convenient to the

company ; but, although paid at the rate of 4s. 6d. per day for seven days in a week, they are employed only five days out of that time. That is, they are given two days' rest each week without loss of pay.

The tide of travel in Manchester, as in Boston, is inward from the suburbs in the morning, and outward in the afternoon, though pleasant weather tends to change these conditions by sending excursionists out of town in the morning and suburban shoppers in and out of town during the middle of the day. The company regulates the number of its trips by its patronage, putting on and taking off cars as demand increases or slackens. The company also owns the omnibuses and hackney-coaches in use in Manchester. The fares in the former are about the same as in the cars. In the latter the rates are 9d. (18 cents) per mile for one or two persons, and 1s. 3d. (30 cents) per mile for three or four persons.

There is no present intention of introducing cable or electric street-cars in Manchester. If there is dissatisfaction among the people at the character of service given, it has not yet found reflection in the city government. One reason for this contentment may be found in the arrangement of the tracks and the width of the streets into which nearly all of the lines converge, these apparently offering little or no delay to travel.

BIRMINGHAM TRAMWAYS.

There are in Birmingham street-railways to the extent of about forty miles of single track. These tracks are owned by the municipal corporation, some of them having been built by it, and others purchased and then rebuilt. The average cost for construction per mile of single track has been \$25,000.

There are in Birmingham four different systems of street-railway transit ; viz., steam, electric, cable, and horse cars. The street-cars propelled by dummy-engines represent the greater part of the mileage. This system is tolerated, be-

cause it was, when introduced, the best possible means of rapid transit; but it is unlikely that official approval could now be obtained to extend this method. The speed of these steam street-cars is limited to eight miles per hour, by law; but at night, and at other times when the streets are free from obstructions, the rate of speed attained is apparently considerably in excess of the maximum limit.

The cable-cars have a speed of nine miles per hour, the electric-cars (storage battery) seven miles per hour, and the horse-cars nominally six miles per hour. As in Liverpool and Manchester, the street-car lines in Birmingham have been laid out by the city authorities. These latter have decided which districts should be supplied and the streets through which the cars should pass. Unlike Manchester, the street-railways of Birmingham do not pass into or through the centre of the city. The streets in that section are not particularly broad, and for this and possibly other reasons it has been thought expedient to describe in the centre of the city a circle, having a diameter of about half a mile, within which area no street-car tracks are permitted. One effect of this is to prevent the direct transfer by street-cars of passengers from one outlying section of the city to the other.

The leases of the various roads have been given out, without competition, to the companies that now hold them, for a term of twenty-one years. These leases include such extensions as the municipality may from time to time construct. Under the terms of these contracts the companies agree for fourteen years to pay annually, in addition to all parish, municipal, and national taxes that may be regularly imposed, four per cent. on the gross cost of constructing the tracks, including in this cost the expense of paving or repairing between the tracks and for twenty-one inches on either side. For the succeeding seven years the rate of payment is five per cent. on the gross cost. Beside this, the leasing companies are compelled to pay the entire cost of all repairs that the city officials consider it necessary to make on the tracks

or the road surface in its immediate vicinity. The possible extent of this last commitment may be judged when it is said that last year a line of railroad of four miles in length had assessed upon it bills for street repairs made by the city amounting to \$50,000. This caused the interested company to make a protest, and there was some intention of testing the legality or equity of the assessment; but, after taking competent legal advice, the company came to the conclusion that there was no appeal from any decision of this kind arrived at by the authorized agents of the city.

The rental charge is paid into the municipal treasury in monthly instalments. The repair charges are paid each quarter, when accounts are made up and sent to the various interested companies by the municipal officials. If bills due either for rent or repairs are not paid with reasonable promptness, the city government has it in its power, in the case of the greatest part of the companies, to bring a direct pressure to bear upon them. The right to use any other power than horse-power is only granted by the city for a term of six months at a time, renewable, of course, at the end of that period. Where, in one or two instances, a railroad company has failed to make its payments at the required time, the intimation that its privilege to use steam-power would not be renewed has been all that was needed to force an immediate settlement of the account.

The companies are compelled in Birmingham to keep their tracks free from snow, and attend to other matters of this kind. As in Liverpool and Manchester, the tracks are, as nearly as possible, on a level with the surface of the street pavement, though the form of rail used in Birmingham and Manchester differs from that used in Liverpool, having a broader surface for the car-wheel to run upon. The city surveyor of Birmingham doubts whether the form of rail used by his city is as satisfactory as that adopted in Liverpool. There are quite a number of accidents occurring monthly, such as the breaking of axles, wheels, etc., in

consequence of the obstruction to street travel caused by the rails, for which compensation is claimed from the municipality; and hence it is good economy for the city to adopt a type of rail which approximates nearest to the ordinary street surface.

Penny fares prevail throughout Birmingham. These apply to single stages, which average about $1\frac{1}{2}$ miles each. At the beginning of each stage the fares are collected for that stage, or the passenger wishing to go more than one stage receives a ticket with a hole punched in it for each penny paid, or each stage to be travelled.

The Manchester street-car companies, particularly those using steam-power, have lines extending miles beyond the corporate borders. These tracks have been put down and are owned by the companies themselves. They are compelled to build these in much the same way that the roads are built in the city, for the reason that the tracks cannot be used until they have been approved by the National Board of Trade officials, who have established the rule of insisting, in matters of this kind, on uniformity of construction.

There is no rule regulating the number of cars that the companies shall run. Seats must be provided for all who ride, and it is the duty of the police to enforce this law, and fines for violation are imposed with more or less frequency. Self-interest, it is assumed, will cause the companies to run all the cars that are needed to obtain the largest number of passengers. In one or two instances tracks have been laid for short distances, and have been leased, but have not been used. If complaints and protests were made by the citizens living in the vicinity of these disused tracks, the companies would probably be forced by the municipal corporation to run cars over them; but, in the absence of such popular demand, the city authorities have taken no action.

When a company in Birmingham obtains the right to open the streets for cable, electric wires, etc., it is compelled to fill in the opening in a suitable manner up to the

dirt surface. Then the city takes up the work and replaces the pavement in its own way by the work of its own men, but at the expense of the interested company.

It is found that while under ordinary conditions a wooden block pavement will last from four to five years and a granite block pavement from fifteen to twenty years, where tramways run through a street, the thoroughfares need repaving at shorter intervals than those given above. The jar of the car service seems to loosen and disintegrate the pavement, making frequent repairs necessary in order to avoid hollows and gullies. It is also found that streets used by tram-cars require more lights and a larger police service than those not so occupied, so that there are incidental expenses to the city that would justify more than ordinary interest charges.

The Birmingham tramway companies have done during the last few years a highly profitable business. The principal company has paid a regular annual dividend of ten per cent., and has accumulated a reserve equal to nearly fifty per cent. of its capital stock. The others have been somewhat less fortunate, particularly the horse-car lines; but all have made at least fair returns to their shareholders.

The overhead wire system will not, it is said, be permitted in Birmingham; but the line which now operates its cars by cable proposes to establish an overhead electric system on a line which it has outside of the city, and which it proposes to extend through several towns. The cars will be run by cable in Birmingham, and by overhead electric wire outside the city border. It is also proposed to run another line by compressed air, at a pressure of 120 pounds to the square inch, and applied by means of a new principle. The power is to be supplied to the car at intervals of, say, one-quarter of a mile, the time consumed in recharging the cylinders averaging not over thirty seconds.

The tram-cars of Birmingham are not in neatness and attractiveness equal to those in use in Manchester. The cars

in Manchester, Liverpool, and Birmingham are apparently lighter in construction than those used in Boston, and in spite of the small rails, level with the pavement, it is said that the horse, steam, cable, and electric cars rarely run off the tracks.

The following general rules apply to the construction, use, and maintenance of street-railways in a large number of cities and towns of Great Britain.

Double lines of tramways are to be laid in no street where the width is insufficient to give a space of at least nine feet and six inches between the outside of the footpath on either side of the street and the nearest rail of the tramway.

City and town authorities, by means of their own carriages and trucks, can make use, free of toll, of the tramways at any time between 12 at night and 6 A.M., for the conveyance of scavengering stuff, road material, night-soil, etc.

Every engine used on the tramways shall have such mechanical appliance for starting and stopping as may be approved by the Board of Trade. It shall have its number shown in some conspicuous place, and shall be fitted with an indicator by means of which the speed shall be shown, a suitable fender to push aside obstructions, a special warning bell, and have a seat for the driver, so placed in front of the engine as to command the fullest possible view of the road before him. The speed at which such engines may be driven shall not exceed the rate of eight miles an hour.

When steam or other mechanical power is used on a tramway, the authorities of the district through which such tramways are laid must make a new arrangement with the interested company, if one has been previously made for horse-power, and the new arrangement shall not continue in force for a longer period than two years.

The money received from time to time from the tramway companies by the local authorities shall be applied by them toward the expenses of repairing, improving, and maintaining the highways within their districts, having regard, in the

first instance, to the requirements of the roads upon which the tramways are laid.

The rails of tramways shall be such as the Board of Trade may approve, and the Board of Trade may require the tramway companies to adopt and apply such improvements in the tramways, including the rails thereof, as experience may from time to time suggest, having regard to the greater security of the public and advantage to the ordinary traffic.

The tramway companies shall pave and maintain so much of any road as extends two feet and one inch beyond the rails of and on each side of any such tramway, and shall pave and maintain the whole width of any road where it is proposed that a space less than nine feet six inches shall intervene between the outside of the footpath on either side of the road and the nearest rail of the tramway.

If, in the judgment of the local authorities, the needed road repairs are not made by the tramway companies, it shall be lawful for said local authorities to stop the tramway traffic along any such part of the road as may be out of repair.

All changes of sewers, water-mains, gas-pipes, etc., made necessary by the construction of a tramway, must be made at the expense of the tramway company.

Tramways built or owned by a municipal corporation may be leased for a term of twenty-one years to companies desirous of operating them.

Companies are authorized, with the approval of local authorities, to lay out penny stages. When such tramways are worked by other than animal-power, these stages need not exceed one mile in length or distance, and the companies may demand and take from each passenger 1d. per stage or fraction of a stage.

At any time after a tramway has been in operation for three years, the Board of Trade may, at the request of local authorities, or interested ratepayers to the number of twenty, revise and change the tolls and charges of a company.

If a municipal corporation shall, at the expiration of the twelfth year after the passing of the act of 1882, or within six months thereafter, give notice to a company of its intention to purchase its tramway, the city shall pay to the company aforesaid a sum equal to the expended capital and the then liabilities of the company, with an additional sum of money sufficient to make up average dividends, at the rate of six per cent. per annum, to the shareholders from the time or times the tramways shall have been opened for traffic up to the completion of the purchase, if dividends at that average rate of six per cent. per annum shall not have been paid out of the profits of the company.

After twelve years, if a tramway is purchased by the municipality, it is necessary to pay the same as above, and the equal of seven per cent. per annum to the shareholders, for the years following the twelfth up to the completion of the purchase, if dividends of an equivalent amount have not already been paid out of the profits.

STREET-RAILWAYS OF BERLIN.

The street-railways of Berlin have only a traction service of horses. It is the wish of the municipal authorities to have electricity, by the conduit system, substituted; but the chief company, Der Grossen Berlin Pferde-Eisenbahn Action-Gesellschaft, is unwilling to incur this increased expense, for the reason that after a number of years the street constructions of all kinds revert to the city, and the company does not care to forfeit an unnecessary amount of property, by investing the fresh capital needed to make these improvements. The Grossen company controls all of the street-railroad tracks of the city, with a trifling exception. It owns about 180 miles of single track, has about 1,000 cars and 5,000 horses. Last year it carried in round numbers 121,000,000 passengers, an increase of 6,800,000 over those carried during the previous year. The company holds its concession until 1911, when all of its tracks pass

into the possession of the city. It will then still retain its horses and rolling-stock, and such real estate as it may own. The company puts down its own tracks, but must use the form of rail that the city authorities direct, and must put this down in a manner to meet, in all respects, official approval. If a street is considered by the municipal authorities too narrow for horse-car traffic, the necessary widening must be made at the expense of the company, which must also pay for all changes that the laying of the tracks necessitate in water-mains, sewers, gas-pipes, etc., and must, moreover, pay whatever expense for street repairs the city authorities consider to be its share. Before undertaking any extensive work to which the company must contribute, the city authorities usually lay the matter before the officers of the company, as a matter of courtesy merely.

The company has to pay for its use of the public streets a tax upon its gross income of four per cent. when this income is but 6,000,000 marks or under, and ascending on a sliding scale to eight per cent. tax per annum when the gross income is 15,000,000 marks or over. The company paid of last year's receipts seven and three-quarters per cent. to the government; that is, a sum equivalent to \$247,625. Beside this, the company has to pay a tax on all of its real estate, an income-tax on its declared profits over four per cent., and, in addition, its stockholders have to pay an income-tax on their dividends, as though the company had paid nothing. In other words, the company is taxed, in addition to what it pays in the way of compensation for street franchise, precisely as any other industrial company in Germany would be taxed.

The city authorities reserve to themselves the right to regulate the rates of fare and the time-table of trips. The president of the company says that the municipal authorities could make him run his cars every three minutes throughout the night by simply ordering him so to do, and a failure on his part to comply would lead to the imposition of large fines.

The company cannot carry in any car more than its seating capacity, and if it failed to provide a sufficient number of cars for ordinary demands, the municipal authorities would instantly cause the omission to be made a matter of official inquiry. The rates of fare are determined by distance, and are 10, 15, 20, and 30 pf. ; that is, $2\frac{1}{2}$, $3\frac{3}{4}$, 5, and $7\frac{1}{2}$ cents.

Seventy-five per cent. of the fares taken are $2\frac{1}{2}$ cents.

Fifteen per cent., $3\frac{3}{4}$ cents.

Five per cent., 5 cents.

Five per cent., $7\frac{1}{2}$ cents.

The average length of a trip for $2\frac{1}{2}$ cents is two miles.

The company has in its employ 3,504 persons. Its operating expenses amounted in 1890 to 57.43 per cent. of its gross income. Dividends have been paid for a number of years past of $12\frac{1}{2}$ per cent. per annum.

The capital of the company is \$4,275,000. There is also a bonded debt of about \$4,000,000. The policy of the company has been to each year set aside a sum of money, the aggregate to be turned over to the stockholders at the end of the concession, to make good the loss occasioned by the forfeiture of the corporate property. On the present basis of savings it is estimated that the shareholders will receive, when the period of concession ends, \$200 for each \$100 of stock held by them. The shares of the company have been recently selling at the equivalent of \$220 for a \$100 share, though the price has been at other times as high as \$250 per share.

There is a strong competition going on between the street-railway lines and the State steam-railway lines. The policy of the latter to reduce their rates of fare and improve their facilities is forcing the street-railways in self-defence to offer larger inducements in the way of fares and more frequent trips.

While in Berlin, as in all cities of continental Europe, there is a disposition on the part of the people to reside within the city limits, and to occupy lodgings in buildings

fronting on business streets and used for mercantile purposes, this method seems to be gradually changing. Each year a proportionately larger number of people find homes for themselves in the suburbs, induced so to do, in the opinion of the State, city, and railroad officials, by the cheap and convenient means of transportation that is accorded to them. In this competition for suburban patronage the advantage possessed by the street-railway company of Berlin is, that its service runs upon radial lines, while the steam-railway takes the form of a circuit; so that in many instances the former, though running cars at a slower speed, furnish the quickest and most direct service. Berlin is growing in number of population more rapidly than Chicago, and it is believed the many thousands of acres of unoccupied land in the suburbs will soon be covered with tens of thousands of small dwellings occupied by one, or at most two, families.

The officers of the Berlin Street Railway assert that, although the government of the city is exceedingly exacting, it is absolutely impartial and disinterested. Not a cent has to be paid for legal fees or lobby expenses of any kind. To offer a bribe to a city official would provoke serious consequences. This comment is made because in Vienna, Paris, and in some other cities of continental Europe personal influence and the corrupt use of money are potent factors in the drafting and enforcement of laws permitting and regulating the use of streets by railway companies.

STREET-RAILWAY AT BUDA-PESTH.

Buda-Pesth, a city of about 500,000 people, is the only place in Europe that has a direct-working electric railway. There are three of these lines already in operation, and a fourth, on a new system, will probably be built next year. (The details of the concessions — translated — under which the lines were built will be sent to Boston by the United States consul at Buda-Pesth.)

The wires furnishing the current for the cars are in a con-

duit underground, access to which is obtained by using a split rail for one of the tracks. The entire equipment was supplied by the Siemens & Halske Company. The nominal rate of speed is eight miles per hour; but at night, and at certain parts of the routes, where there are substantially track reservations in the streets, the speed attained is from ten to twelve miles per hour. The price for a trip in the electric and horse cars is six kreuzers per stage; that is, about $2\frac{1}{2}$ cents for an average distance of two miles. It is said that the electric cars at Buda-Pesth experienced no more trouble with snow and ice last winter than the ordinary horse-cars. There was some delay, but nothing serious, although last winter was one of exceptional severity in Hungary, and the Danube river was frozen over continuously for more than three months.

The electric and horse cars in Buda-Pesth are not allowed to go in the centre of the city on the north side of the river. A space of about two-thirds of a mile long and half mile wide is kept free from tracks. Exchange tickets are sold by the lines which admit of transfer; but those going in a direct line across the city would be compelled to walk, or take some other form of conveyance for a part of the distance.

The new line which it is proposed to build next year is planned on a wholly new principle. The invention is controlled by Messrs. Ganz & Co., manufacturers of railroad and electrical supplies, who have large workshops at Buda-Pesth, where they give employment to several thousand persons, and where they have on exhibition a large working-model of their car, track, etc. This car runs upon a single split rail, drawing its supply of electricity and obtaining its support from a conduit reached by the open space between the two sections of the rail. By this means the disfigurement of the street surface is reduced to a minimum, in fact is done away with, and it is claimed that relatively less trouble than at present would be experienced in keeping the lines free from the obstructions of snow and ice. Beside this, the

cost of street repairs would be very slight. The cost of building and equipping a line of this kind is estimated at \$39,000 per mile, this not including central power stations. Messrs. Ganz have an automatic device by which the cars themselves turn the switches, when a single track with turn-out is employed.

TRAMWAYS IN VIENNA.

These are very thoroughly reported upon by United States Consul Goldschmidt in his recent letter to the State Department, which will soon be printed in the consular reports. In addition, all that needs to be said is that the tracks are not laid in any street within the Ring-Strasse, which surrounds the centre of the city.

The street-cars in Milan are, in cleanliness, attractiveness, etc., quite the equal of Boston street-cars, and are in this respect superior to the cars of any European city that I have seen.

UNDERGROUND RAILWAYS.

THE GREATHEAD TUNNELS.

The tunnel railway in London, which has been one of the chief reasons for this investigation and report, is a system about which it is somewhat difficult to speak. If the so-called Greathead tunnels, with their stations, trains, etc., were to be literally copied in Boston, they would not give general satisfaction. They do afford a reasonably speedy transit. The distance from the Monument in the city to Stockwell on the south side of the Thames is three and one-quarter miles, and the space is covered, with unnecessarily long waits at the four intermediate stations, in fifteen minutes. The speed might easily be increased, and the delays at stations reduced, so as to make the distance in ten minutes. So far the plan is a success, and in judging of other less satisfactory features it is only fair to take into account the conditions under which the tunnels were built.

The undertaking was in the nature of an experiment. Before those interested in tunnel construction of this class could obtain from Parliament the charter they desired, it was necessary to prove by an object-lesson that tunnels of the type proposed could be built, and, when built, could be successfully operated. The route selected for this trial was one from which a very large patronage could not be hoped for, and it was obviously for the interests of the promoters of the line to spend upon it no more money than was imperatively called for. The total cost was about £600,000, but the work shows the effects both of cheap construction and the conditions under which it was carried on. The tracks are not evenly laid, unlike in this respect most English railroads; the cars are cheaply built, with poor springs and dingy furnishings, and are badly lighted, even though electricity is used, while the stations and their appointments are exceedingly unattractive.

Beside those defects, due in part, perhaps, to poor taste or bad judgment, but more to an insufficient supply of money to properly perform the work, the company was compelled to build its two tunnels under the public streets, except when crossing under the river. This necessitated carrying the tunnels immediately after leaving the station in London, one above the other, through a lane of only twelve feet in width, reached by a curve and descent so sharp that the under tunnel of the two is built on an incline of one foot in fourteen, — and this on a curve having a radius of one hundred feet (one and one-half chains). This may be a skilful piece of engineering, but it gives to the train a corkscrew motion, the disagreeable features of which are intensified to the passenger by the hard riding qualities of the cars. This is the worst point of all; but there are other places where the necessity of following the line of the streets has caused abrupt turns, that are not productive of comfortable travelling. Beside this, the size of the tunnel is small, ten and one-half feet in diameter; and as quite a part of this space is

taken up by the hydraulic pipes, — which, receiving power from the central station at Stockwell, are used to run the elevators at all of the stations, — there is hardly more than nine feet in diameter allowed for the cars. The cylindrical form of these cars gives them a greater apparent size than they possess; but they are not large enough, either in fact or appearance, to suit American tastes. In consequence partly of the flanges of the iron covering, which at short intervals protrude into the tunnel for a distance of an inch or two, and partly because each tunnel is a single-tracked one, there is a great and decidedly objectionable noise produced when a train proceeds at a relatively high rate of speed. This could be materially lessened, as it will be in the New Central London tunnel, by giving a smooth surface to the interior; but, after passing through some two or three score of single and double tracked tunnels in Austria and northern Italy, I am of the opinion that a tunnel having dimensions only for a single track holds, echoes, and reëchoes the sounds produced by a passing train in a manner quite without its parallel in a double-tracked tunnel.

It will be seen, from what has been said, that there are a number of serious defects in the Greathead tunnel system, as it is exemplified in the London and Stockwell line. The question to consider is whether the merits of the system could be taken and its defects rejected in an American adaptation. It would be necessary to continue the single tunnel feature, for by means of this the expense is reduced and a cheap, easy, and tolerably fair method of ventilation is secured; and if the tunnels were made smooth on the inside, by filling with cement the spaces between the flanges, it is probable that the noise now complained of would be very decidedly reduced. The stations, the elevators, the tracks, and the cars could all be made so as to be much more sightly and comfortable — one or both; while if the tunnels could be run between stations in practically straight lines, not a little of the discomfort incident to travel in the London

tunnels could be avoided. In other words, the Greathead system furnishes the suggestions, at least, of a method of urban rapid transit, which might be wisely adopted in Boston, if it is thought desirable to have a system of rapid transit entirely independent, though connecting, with existing systems of transit, either of steam or street railway.

The trains start at intervals of five minutes, this being in accordance with Board of Trade regulations, which permit no train to leave a station until the train in front has left the preceding station. The engines have electric motors attached directly to their axles, thus doing away with gearing, and also with a large part of the noise incident to the use of motors on our cars.

Mr. Greathead proposes in the new tunnel, which will be four and one-half miles long, to run trains at very short intervals by means of automatic devices which will prevent a following train from obtaining electric power when it approaches too near to a preceding train, and he will also arrange methods by which the signal men can shut off the power from any train at their pleasure.

The Central London tunnel will have a diameter of eleven and one-half feet. Mr. Greathead estimates that it will cost about four shillings per square yard to remove the earth, and is of the opinion, from his experience as consulting engineer of the North-river tunnel, that the expense would not be much more in the United States.

At the Stockwell station there is an opening to the surface of the ground, this consisting of a tunnel having an ascent of one foot in ten, up which the cars and engines are dragged by hydraulic power, when it is necessary to repair them. There are at the central station three engines, two constantly employed during the hours of train service.

METROPOLITAN AND DISTRICT ROADS.

The underground steam-railways of London are owned and worked by the two above-named companies. The

former is the older organization, and its line is located, in the main, about a mile and a half north of the Thames, running east and west, and connecting with the steam-railway stations on that side of the city ; while the District Company's line follows substantially the north bank of the river, connecting with such of the surface railroad stations it passes by subways and stairways. The two lines form a circuit of fourteen and a half miles, around which trains are run in each direction at intervals of about ten minutes. Beside this, several of the surface railway companies run a number of their suburban trains, some over the circuit and others to certain central points on one or the other of the two lines. In addition, both the Metropolitan and District Companies have built suburban branches (surface roads), and trains are run from these both over the inner and also over what is called the outer circuit. Altogether, eighteen trains an hour are regularly run during the day, through the greater part of the tunnels, and for a short time in the morning and evening twenty trains an hour are run. This, however, is the limit of capacity, particularly in view of the crossing of the tracks occasioned by connecting roads.

In the morning and evening the trains are full, but in one direction ; but during the middle of the day, and also in the evening, the patronage is relatively small. It is, however, found more convenient, and even cheaper, to keep all but the few extra trains mentioned running from morning to night, rather than to haul them off when demand slackens. The system of train-running is made safely possible only by the most careful method of signalling. When distances between stations are short, a train is not allowed to leave a station until a signal has been received that the preceding train has left the station in advance. When the distance between stations is longer, the train is allowed to go as far as signal lights placed in the tunnel ; but must then stop, unless the signal is given to go on. In foggy weather the companies have men stationed at every signal-light to warn the engineers if the signals cannot be plainly seen.

The service begins at 4 A.M. and ends at midnight. The men in the signal stations are worked in three shifts, each man serving something less than eight hours a day. They are paid from \$6 to \$7.50 a week, and have every other Sunday off. The engine-men work in two shifts, serving about 10 hours each, and are paid about \$2 a day. Firemen working under the same conditions get about \$7 a week; guards, or conductors, about the same as firemen. There are two guards to each train.

The time required for making the circuit trip is one hour and ten minutes. The fares are, in substance, for short distances: per mile, first class, about 4 cents; second class, about 3 cents; and third class, about 2 cents. For longer distances the rates per mile are about two-thirds of those just given. Season tickets for first and second classes are sold for one month, three months, six months, nine months, and a year, for unlimited use, which, if used daily in making one trip in and out of town, would represent a reduction in fare of about 15 per cent. for the shortest, and 30 per cent. for the longest time stated.

The two roads each carry in a year about 40,000,000 passengers over their lines. They pay the interest on their bonded indebtedness, but give little or nothing to their stockholders. This financial result is due, partly to the great cost of construction, averaging \$4,000,000 per mile with the District road, partly to the conditions under which the money originally subscribed was obtained, — that is, on the basis of two-thirds actual cash payment, — and partly to losses caused by injudicious extensions. Until a few years ago the two roads connected at the West End of London, and together took the form of a horseshoe, the District road stopping at the Mansion House, and the Metropolitan at Aldersgate. It was thought that the closing of this space and the formation of a circuit road would greatly improve the business and receipts of both roads, hence the two companies each built lines to Aldgate East, and then jointly from that station to

Whitechapel, Mile End. While this extension gave, beside the circuit route, a connection with the East London railroad, its construction appears to have been, financially considered, a mistake, especially in the case of the District Company. The extension it built had a length of rather more than a mile, and cost to construct fully \$5,000,000 per mile, while its existence has added but little to the revenue of the company.

The tunnel railways are compelled to pump constantly at eight different places to keep their lines free from water. The air in the tunnels is not seriously objectionable, but this result is obtained by having at intervals large openings over the track-way — which, of course, involves the surrender of land that might otherwise be built upon — and by using exhaust fans, run by gas-engines, at a number of different points. The noise in the tunnels is certainly less than in the single-tracked Greathead tunnels.

The tunnel lines are only of use for urban and suburban travel. No long-distance trains are run over the lines, although transfer connections can be made at the different stations if passengers have no heavy luggage. There is no provision made for handling trunks and the other large impedimenta of travel. It is held that to attempt this would involve delays at the stations, and that it is better for those coming or going over long-distance routes to take a carriage to go to or from the stations and their homes or hotels. The cars upon the underground lines are much the same in style and construction as those used upon the surface railroads in England, but the newer cars are built lighter.

As may be inferred, these underground roads are not financially successful, and it is questionable whether they can ever be made so. Mr. Powell, the general manager, assured me that if it were not for the suburban branches his company has built, it could not have avoided bankruptcy. But these branches, which are surface lines, cannot increase the number of trains they now run through the tunnel. For,

according to Mr. Powell's working assistants, while thirty trains an hour could be run around a strictly circuit road, with ease and safety, twenty trains an hour is all that can be run on the same circuit, when these trains are taken from or delivered to connecting lines of road. That is, when branch lines are connected with a circuit road, the delays incident to the crossing of tracks and to the providing of regular times for the running of these outside trains, make very rapid and frequent service impossible. The larger the number of connecting roads the more serious the delay. In order to improve its financial condition, as it must if its shareholders are to receive anything, the District Company should enlarge and stimulate its suburban service; but its main tunnel line is now so occupied by trains during the busy hours of the morning and evening that it does not seem probable that it can add much to this part of its service, even if the demands of its suburban line became much more exacting. Mr. Powell's opinion was that a metropolitan line should be either a circuit road, without direct connections, — that is, one where the passengers should transfer themselves, which, he admitted, would be an unprofitable system for the London District road, — or should be built upon radiating lines. This last theory of radiating lines is one held, it may be added, by Mr. Greathead, who will, no doubt, embody it in his future construction in London.

PROPOSED TUNNEL SYSTEM IN PARIS.

In spite of the wide streets and boulevards, and the numerous omnibus and tramway lines in Paris, and the system of circuit railroad, maintained by the Railroad Company of the West, the people of that city are greatly dissatisfied with their local methods of transportation. It exhausts quite an hour and a half to go from one side of the city to the other, and at certain parts of the day the crowd of vehicles in the chief streets is so great that if it were not for the admirable regulations established and enforced by the police

authorities, a complete arrest of travel could hardly be prevented.

There have been a number of projects prepared for meeting and overcoming this defect. The one which seems to have the best chances of success, because it has been prepared by a distinguished engineer, M. Eiffel, has the support of wealthy capitalists, and is to some extent approved by the great railway companies, consists of a circuit route through the central part of Paris, of about seven and one-half miles in length. Nearly two-thirds of this would be by tunnel, and one-third by viaduct; at least this is the length of the last Metropolitan road proposed, and the relative proportions of under and above ground track. It is probable that this plan will be in a number of ways modified before it is definitely adopted. M. Eiffel's first intention was simply to obtain a concession from the government permitting him to form a company to build this road, under an agreement to divide with the government all profits over 8 per cent.; but, apparently, he has not yet succeeded in obtaining the approval of the Minister of Commerce, or in winning the consent of the municipal council of Paris, and it is also intimated that, failing to obtain by private subscription the money needed, the next proposition will be for the State to guarantee interest and principal on the bonds that may be issued for the money needed to build this road, which may be undertaken either by one of the great railway companies, such as the North or West, or by a corporation formed for that purpose. The cost of the work proposed in the last plan was estimated at about f.84,000,000, or say \$2,400,000 per mile. By this plan it was designed to tunnel under a number of the principal streets, and to use other streets, or their sidewalks, for the elevated railroad structure, which was to be in construction somewhat similar to that in use in New York City. The part of Paris where it was proposed to elevate the road is devoted to manufacturing purposes. It is hardly necessary to dwell on this project, still in an unformed condition,

except to remark that in Paris, as in other large cities, the need of some special means of quick transportation is coming into general recognition. The promoters of the plan referred to say in their memoir: "No question is more worthy of interest to the public authorities, for its solution is intimately bound with the amelioration of the conditions of existence of the classes the most numerous and the poorest." These, they go on to say, are now "frequently compelled to lose valuable time in exasperating delays at the omnibus stations, or in fatiguing walks,—time which often represents to them an important part of the period of repose after their work."

MERSEY TUNNEL.

There is a tunnel under the river Mersey, at Liverpool, connecting that city with Birkenhead. This was built, and is owned and operated, by the Mersey Railway Company. The work of construction was exceedingly expensive, and the tunnel and the railroad running through it have never been financially successful. This is said to have been due to the fact that the tunnel road had no connections. This error, if it was one, has been recently corrected, and passengers can now take the tunnel line for points some miles south of the river.

ELEVATED RAILROADS.

THE STADTBahn OF BERLIN.

The elevated railroad in Europe which has deservedly the highest reputation is the Stadtbahn of Berlin, particularly when taken in connection with its connecting roads, the North Ring and the South Ring. The cost of the main line, which is 8.8 miles long, is stated to have been 65,000,000 marks, or, say, \$16,270,000, this covering the outlay needed to build the viaduct and the structures of a four-track road. The location of this line was determined by the two terminal stations at the east and west ends of the city, the Friedrich-street station, in the centre of the city, and the wish to

connect these three together at the smallest expense, without too great deviation from a direct line. There were no walls or other open spaces, except the river Spree, that could be utilized; the land needed had to be condemned and purchased as in ordinary railroad construction. At one point the price asked for the land was so great that it was thought advisable to utilize a part of the river; but the statement is made that by reason of the unsatisfactory foundations obtained, and the need the builders were under of providing better ones, it would have been quite as cheap, if not cheaper, to have purchased and built upon the high-priced land.

The main viaduct is a masonry structure, except where a street-crossing is made, when iron bridges are employed. The reason given for building a stone rather than an iron viaduct is that the former, but not the latter, will permit of the readjustment of the tracks in any manner that may be desired. In the suburbs the desired elevation is obtained by means of embankments. If the road were to be rebuilt, arrangements would be made to utilize the space beneath the tracks. Where by chance open arches have been left that can be utilized for store purposes, it has been found that the space can be rented, particularly near the stations, to exceedingly good advantage.

There are four tracks throughout the central road or Stadtbahn, — two for distant travel, and two for local business. These are kept wholly distinct, and the long-distance trains do not stop at any but the larger stations on the line, and at these take or leave only passengers coming from or going to a long distance, — that is, some place outside of the local service. At the present time the local trains are run at a headway of five minutes, and during quite a part of the day twelve trains an hour are run each way through the local service of the main line; but in a short time more the fares are to be reduced on the lines, and at the same time a larger number of suburban trains are to be put on, so that, with

a headway of three minutes, there will be twenty trains each way per hour. These trains run with from eight to ten cars, each car carrying fifty passengers. The local trains stay in the stations, on stopping, from fifteen to twenty seconds. The European type of railroad cars lends itself to the quick egress and ingress of passengers. The only defect is, that some of the compartments may be crowded with people, while in other parts of the train there may be compartments with but one or two passengers, or, perhaps, with no passengers in them. On the local trains there are only two classes of cars — second and third. The rates of fare in the third class are 10 pfennigs, or $2\frac{1}{2}$ cents, for a distance represented by five stations or less, and 15 pfennigs, or $3\frac{3}{4}$ cents, for the same distance in the second-class cars. This distance is to be increased, with no change in price, to at least six stations instead of five, for the purpose of encouraging local travel, and inducing settlement in the suburban districts. The manner of selling commutation tickets is highly commendable on account of its regularity. The tickets are issued without limit as to the number of times that their holders may ride while having them, at the following rates : —

1 month the equivalent of	.	.	.	30 single fares.
2 months the equivalent of	.	.	.	50 single fares.
3 months the equivalent of	.	.	.	65 single fares.
4 months the equivalent of	.	.	.	80 single fares.
5 months the equivalent of	.	.	.	95 single fares.
6 months the equivalent of	.	.	.	110 single fares.
7 months the equivalent of	.	.	.	125 single fares.
8 months the equivalent of	.	.	.	140 single fares.
9 months the equivalent of	.	.	.	155 single fares.
10 months the equivalent of	.	.	.	170 single fares.
11 months the equivalent of	.	.	.	185 single fares.
12 months the equivalent of	.	.	.	200 single fares.

If a person holding a season ticket of three months or more wishes to leave town for a period of fourteen days or more, he may, by giving notice at the registration office, have his ticket extended for a period equivalent to that which he does not propose to use it.

The main line is 8.8 miles long, with ten stations, or an average of one station in .88 of a mile.

The North Ring route is 12.56 miles long, with twelve stations, or on an average of one station in 1.045 miles.

The South Ring route is 16.30 miles long, with nine stations, or on an average of one station to 1.8 miles.

It will be seen, when general averages are taken into account, that the single rate of fare which now obtains gives a ride of about five miles on the railway for $2\frac{1}{2}$ cents in the third class, and $3\frac{3}{4}$ cents in the second class.

The running time from one end of the main line to the other, including stops (8.8 miles), is twenty-nine minutes.

Through the main line and over the North Ring (21.36 miles), one hour and twenty-five minutes.

Through the main line and over the South Ring (25.10 miles), one hour and twenty-five minutes.

This speed, while not high, is probably as great as that of any similar service in the world.

Where the stations are far apart, as on the South Ring, the effect of the system adopted of fixing fares is to benefit this somewhat sparsely settled district, by granting to it transportation at very low rates, for the policy of the government, as embodied in the direction of the road, is to encourage the building of suburban residences. It may also happen that, by grading fares on the station basis, the railroad authorities can prevent the demands for too frequent stations, as the establishment of a new one would have the effect of increasing fares to many who lived at stations beyond the one desired, and their protests against such establishment could probably be counted upon.

The roads of the North and South Rings follow in the

main the surface of the ground; but there are no streets crossed at grade, nor is there any railroad track crossed except at different elevation. This statement does not of course apply to the points at the two ends of the main line, where the trains leave it for the North and South Rings. Here the tracks of the local, though not the long-distance, service are crossed at grade, and will continue to be until the main line is provided with six tracks, — two for distant business, two for the North Ring, and two for the South Ring trains. This increase in tracks would involve large additional expenditures, but the railroad officials appear to believe that it will before long have to be undertaken. When the road was first built the criticism was made that it was far too extensive for the demands of travel for a generation or more to come. But though the main line was formally opened in February, 1882, the passenger traffic upon it has grown so rapidly that already the question of the sufficiency of facilities has been brought up as a matter needing immediate attention. With two tracks only devoted to the local service, and with a maximum number of twenty trains an hour each way, it is probable, considering the hours of travel, that 150,000 passengers a day would be all that the main line could carry; and although this number is much more considerable than that which would represent those now carried, it is no larger than the number who daily arrive and depart from a single London station. The Stadtbahn and the Ring Bahns of Berlin have, in the opinion of good authorities, tended greatly to stimulate the growth in population of the city; but that growth is having the effect of making insufficient the facilities furnished.

Freight trains are not allowed upon the main line during the day. On the South and North Rings they are permitted, as in this way only can they reach a number of the freight stations. At the present time, work is going on which, in four or five years more, will give to both North and South Rings a complete double-track freight service, entirely distinct from the passenger lines.

The main line serves to supply the central market of Berlin. Cars filled with food supplies, other than live animals, arriving during the day, are kept on side tracks on the Ring lines until midnight, when, with such other provision cars as may have arrived during the evening, they are brought to the side tracks of the market near the centre of the city. Here they are immediately unloaded, and their contents let down on large hydraulic elevators to the main floor of the market, which is on a level with the surface of the ground. The supplies thus received and delivered aggregate from one hundred and twenty to one hundred and sixty carloads each night. The side tracks of the market will not accommodate more than forty freight cars at a time, hence when unloaded they are immediately taken away to make room for others. When, a few years ago, this market method was introduced to take the place of the general sale of produce from carts, it aroused great opposition, which has now, however, wholly died out, from the discovery that by the new method the prices of food supplies have been sensibly reduced. The market is owned and stalls leased by the city, but the management of the market traffic, until the produce comes within the walls of the market, rests in the hands of the State officials.

The same system obtains in the management of the Berlin slaughter-houses, which are located on the North Ring, and at which as many as 49,000 head of animals of all kinds have been landed in a day (the average daily supply is 30,000). Here, too, the service of delivery is largely performed at night; though when the special freight tracks are completed this will not be necessary.

The long-distance passenger service on the Stadtbahn is confined to trains going east and west; those railroads running northward or southward from Berlin having their own main stations, though connection can be made with their line by one or the other of the Ring roads. It is probable, however, that this method is not often employed. The trains

running east and west from Berlin pass over the Stadtbahn. The trains going east start usually from the west end of the city, stopping for two or three minutes' time at three or four of the main stations on the route. Similarly, long-distance trains for the west start from the east end of the city, and take up their passengers as they proceed westward over the Stadtbahn.

While this railway system is of great strategical value to Germany, giving an advantage, it is said, of at least one day in the mobilization of the army, it was originally planned both by MM. Orth and Hartwich with an eye to ordinary rather than extraordinary purposes. Its construction was first undertaken by a company formed for the purpose, which was to be assisted by the government, and it was only when this company failed to keep the engagements it had made that the national government took up and finished the work.

THE LIVERPOOL ELEVATED ROAD.

This new overhead railway in process of construction at Liverpool is owned and will be operated by a private company, which has acquired the concession from the Liverpool Dock Board (which is, in substance, a branch of the city government; such, for example, as the Boston School Board is) for a period of nine hundred and ninety-nine years. By the terms of this concession the railway company pays to the Dock Board a ground rent agreed upon, for the land occupied by it; and further agrees to divide its profits with the Board, after paying five per cent. per annum to its shareholders. The Dock Board reserves the right to terminate the lease at any time by the purchase of the structure and equipments at an agreed-upon valuation. The road will be put in service in about a year more. It will be operated by electricity, the cars taking it from a wire fastened to the structure. It is the first elevated railroad, so called, that has been built in Great Britain; and the estimated cost of construction and equipment is \$400,000 per mile.

It runs at the side of and on the line of Regent's road, along the water-front of the entire city, but is almost wholly within the boundaries of the Dock Board property. Its length, when completed, will be six miles. The structure is ordinary post and girder, providing for two tracks; the landing-places are to be at the entrance of each dock-yard. These will apparently be little more than open platforms. Where the track, of necessity, extends over the public street, the company agrees, in consideration of no further charge, to pave, light, and keep clean the street at these points. The speed at which it is proposed to run the cars on this line is at the rate of twenty-five miles per hour.

ELEVATED RAILWAY IN PARIS.

There are two projects for elevated railways in Paris which are under consideration; but it is exceedingly doubtful — though for different reasons — whether either of them will ever take definite form. The first is the plan of M. Haag to connect the Railroad of the West (the St. Lazare station) with the station of the Lyons railroad, by means of a masonry viaduct. This would give a road crossing the city, but would hardly supply the need of those living at any distance on either side. The most serious obstacle in the way of the adoption of this plan is its cost, which is estimated at more than \$12,000,000 per mile.

Another project is that proposed by M. Charles Leroux, who is endeavoring, with questionable success, to educate public opinion in Paris to the imperative need of rapid transit, so that it will demand a series of elevated railroads, built through the principal streets and boulevards, which would be a copy of the New York elevated road. M. Leroux estimates the cost of his structure at \$1,600,000 per mile of double track. He does not include in his estimates any outlay for damages to abutting property or royalty to the city or State; admitting that the former charge, if it were imposed, would render impossible the construction of his

road. M. Leroux is carrying on his missionary work with a great deal of energy; but although it is difficult to predict future events, it may be said that few persons spoken to would admit for a moment that the Parisians could be induced to consent to this disfigurement of their streets, to say nothing of making no demand for damage done to adjacent property.

TERMINAL STATIONS.

Although there can be no doubt that in the facilities for long-distance travel the railroad companies of this country have little or nothing to learn from experience of railroad companies in Europe, it is almost equally certain that in the handling of short-distance passenger traffic, in the construction of terminal stations, and in the utilization of terminal facilities, the European (particularly the English) companies are as far in advance of the American as the American companies are of the European in long-distance travel. Their stations are better arranged for business, their light compartment trains are possibly better adapted for quick movements, while in the handling of their engines, trains, and passengers, their methods are so far superior to ours as to be almost beyond comparison.

THE NORTH LONDON STATION.

The North London railroad, having its station on Broad street, is a strictly local road, devoted to suburban business. During the month of August it sent out and received each day at this station, on the average, 620 passenger trains, 35 "empties," 20 light engines (engines without trains), and 70 goods trains — in all, nearly 750. It sends out and receives each year more than 40,000,000 passengers; that is, about as many as all of the steam railroads of Boston combined. These are received and dispatched in a station having nine bays or tracks. Near the entrance of the station there is a short siding to each track, simply long enough to hold a

locomotive, which can there receive the water and fuel it needs. When a train from the suburbs enters the station, and the passengers have alighted, the engine on this siding draws out and connects with what was the rear end of this train, and after a wait of from five to ten minutes, as the case may be, this same train starts out upon another trip. The engine that brought it in then backs down, enters the siding, and is in readiness to take out the next train that enters the station on that track. The trains are kept running like shuttles from morning until night between the country and the city stations. The time for the departure of a train is placed at from five to ten minutes after its arrival, whether that arrival is morning, noon, or evening. There are, as the term "empties" used above indicates, a few extra trains put on in the morning and evening when the pressure of travel is greatest; but these are apparently kept, when not in use, at suburban stations, rather than at the city station. A short distance outside of the station the tracks are reduced to four, these falling to two after several branches have been passed.

A mile outside of the London station is located a signal-office, from which, by dial, the signal-man in the box immediately in front of the station is notified of the train that is approaching. On receiving this information, he signals to the station to know whether the regular track or bay for the coming train is ready for its reception. If it is so, the train is shunted by ordinary methods into its proper place; but when once there, by an automatic process, worked by the train itself, that bay is locked, and no other train can be shunted into it until the first train has left. The traffic manager of this road asserted that if he attempted to follow the American method in making up and dispatching his trains his business would be thrown into hopeless confusion. In order to do his business he must, he said, keep his trains moving, and this, while absolutely necessary to prevent congestion, was about as cheap as to have them lie idle. The trains are cleaned out by light brushing when in the stations,

probably oftener at the country than at the city station. But the English method of having the stations built with broad platforms and glass roofs, and the opportunity to enter the cars from the sides, tend to facilitate this work.

THE GREAT EASTERN STATION.

The Great Eastern railroad, at its station in Liverpool street, London, takes in and out a larger number of passengers than enter and leave any other railway station in the world. The daily average this year has been over 170,000, or, say, including Sundays, 55,000,000 in a year, against a much smaller annual average for all the stations of Boston. In spite of its great business, this company has the highest record in England for prompt arrivals and departures, this determined by Parliamentary inquiry. The greater part of its passengers come in and go out by its suburban service. For this it has at its station nine lines of track, with five others for its long-distance trains, the latter entirely separated from the former. These suburban trains are received and sent out in the same manner that trains in the North London station are handled, forty coming and leaving in an hour in the busy part of the day, the average for the day being five hundred and twenty. The suburban trains to this station stay there hardly more than five minutes. The long-distance trains, which are made up and brought into the station in much the same way that our American trains are, stay there for a half-hour or more. The company has for some distance from its station six lines of track. Although its passenger business is large, the company has never paid to its shareholders more than three per cent. per annum in dividends. This is due to the immense obligations to which the so-called railroad king, Hudson, committed the company nearly fifty years ago, in constructing a large number of unprofitable lines in the eastern part of England, lines which have never yet paid expenses. But the company believes that its future welfare is to be found in encouraging the profitable and growing part

of its business, that is, its suburban service, which has lately increased at the rate of about fifteen per cent. per annum. On this account, in spite of its strained financial condition, it has raised and is now spending \$10,000,000 in enlarging and improving its Liverpool-street station, for the purpose of better accommodating its suburban service. While the average fares are about a penny a mile, this road is compelled by act of Parliament to run a workingmen's train out and in for twenty miles, on which the fare for a part or the whole of the distance is one penny. As an illustration of its commutation rates it may be said that a season ticket for a year, unlimited as to use, is sold, second class, for a four-mile run, for about £5, or \$25.

THE ST. LAZARE STATION.

The St. Lazare station in Paris of the railroad of the West is the one which corresponds nearest to the two stations in London just referred to. To show the increase that has taken place in its suburban business it is only necessary to say that in 1858 the number of local trains in and out was seventy-two daily, and passengers carried, 6,438,644 yearly. In 1890 the number of local trains had grown to 306 daily, and passengers to 26,301,617 yearly, these figures covering merely the suburban service. During the time of the French exposition as many as 225,000 persons often used the station in a day. The company owns and operates a line which runs completely around Paris, just inside of the walls of the city, and beside this has lines running to Versailles, St. Cloud, St. Germain, Argenteuil, Pontoise, and other suburban towns. In this respect no other French railroad can compare with it. The St. Lazare station is an immense building, upon which the company has recently spent more than \$1,000,000 in the way of enlargements and improvements. In this station there are twenty-five tracks, sixteen of which are devoted to suburban business. The arrangements made for receiving and sending off suburban trains differ somewhat from the

methods in use in London. When a train arrives it runs into a bay in the station which has two tracks. At the end of each of these bays, nearest the head-house, is a small turn-table and a shifting platform, both operated by hydraulic power. The engine is turned and shifted to the parallel track in less than a minute's time, and if that track is vacant it can go out and back down to the other end of the train it has just brought in, or, if the track is occupied, it can go out just as soon as the train which stands in the way has left. This method is considered in Paris better than the London one, as the engines are turned, and a transfer of them from train to train is made unnecessary. Some idea may be formed of the magnitude of the work performed at St. Lazare from the statement that there are regularly employed there, for strictly station purposes, 700 persons, who are each paid, on the average, from \$250 to \$300 per annum. On holidays and other special occasions the number is increased to about 1,100. This does not include freight-work, except what is called express freight; that is, that which goes with passenger trains. At St. Lazare, as with other great railroad stations in Europe, a large use is made of hydraulic power for passenger and freight purposes. Where the stations proper, as is often the case, are above the grade of the street, hydraulic elevators are used to take the trunks of the passengers up and down, as these are ordinarily received and delivered in rooms on the street grade. With freight, two floors of a freight station are often utilized. The freight-cars are hoisted by hydraulic power to the second floor, and by means of turn-tables and winches worked by hydraulic force are easily carried to any point that may be desired, while cranes furnished with the same power quickly transfer the contents of the cars to the teams, or that of the teams to the cars. In a word, a use of mechanical power is made in these matters, which is to a great degree without its parallel in this country.

In the storage and repair of locomotives it has been found

that the old-fashioned "roundhouse" is uneconomical, because it occupies too much ground for the accommodation it gives. The new engine-houses are, therefore, made rectangular, with lines of parallel track, and with small turn-tables and shifting-platforms, worked by hydraulic power, wherever these are thought necessary.

As will be seen from what has been said, the railroad companies which carry on a large suburban business believe that they are amply justified in freely spending their money to develop it. The principle laid down by the best European railroad authorities is, that a railroad company should seek to devote such money as it has at its disposal to what may be called responsive business; that is, business of a class where expenditures in the way of improved facilities will lead to almost immediate increased patronage. The experience of these roads is that their suburban traffic fulfils this requirement more nearly than any other class of their business; hence those which are the most successful are the most liberal and progressive in the administrative policy they have adopted.

RATES OF FARE.

The railroad systems of Europe were, perhaps, never so greatly and immediately influenced by any action as by that taken by M. Baross, the Hungarian minister of commerce, in establishing the so-called "zone" method of fares. The result in his case, as is well known, has been a wonderful success. The railroad patronage of the kingdom of Hungary has increased in two years from the rate of about 4,000,000 to the rate of nearly 20,000,000 persons per annum. The receipts have, of course, increased, but nowhere near in the proportion as that of the passengers. This result has naturally attracted a wide attention, and wherever the railways are under government, or semi-government, control, a similar movement for a revision of fares has been begun.

In Austria it has been in part carried out, and in a few

months more the new minister of railways of Germany will probably report a plan of fares for the railways of that empire, based on the general principles of the zone method. At least, the statistics needed to enable him to arrange such a plan are now in course of preparation. For the suburban service of Berlin the theory has already been accepted, and it is only a question of how far to extend the opportunities for travel afforded by the present rates of fare for short distances. In Paris the question of rates of fare is complicated by a tax imposed by the government, and the companies are desirous of having this modified or removed before moving in the direction of lower rates.

M. Baross said that he wished to do away with a misapprehension to which the term "zone" had given rise. The fares were graded, not by districts, but by distances. In his plan any station was the centre of the system. He wished to sell tickets from any station in the kingdom for ten, twenty, thirty, or more miles of continuous travel at the same prices as tickets for similar units of distance were sold for elsewhere. At the present time, for financial reasons, the system centres at Buda-Pesth, and on this account one travelling from the eastern to the western end of the kingdom is compelled to buy a ticket to Buda-Pesth, and from that city onward. But this qualification is made because it was thought too much of a risk to apply the scheme at first in its entirety; for, as all travelling beyond a distance of, say, 140 miles is free travelling, it was feared that, for a time, the revenue derived from the roads would be reduced to an inconveniently low point; that is, that with such an inducement long-distance travel would increase at a more rapid rate than short-distance travel. By the break in the system established temporarily at Buda-Pesth, an opportunity is afforded for the business to adjust itself to its new conditions. One of the objects of the method is to stimulate the desire of the workers in the cities to live in the country districts, by establishing between the two points cheap and easy means of

transportation. There is to be said in relation to an application elsewhere of the method used at Buda-Pesth that it is there an effort to create a now almost non-existent condition of affairs. It is a city with about the same population as Boston, but with practically no settled suburbs. The railways of the entire kingdom of Hungary are now carrying in a year about 20,000,000 passengers, or about half as many as now in a year come into and go out of Boston by our steam-railways. On the other hand, the two great railway stations at Buda-Pesth are, either of them, apparently, larger and better adapted to meet the demands of a great passenger business than any two stations combined that we have in Boston. They have facilities in excess of demands; we have demands up to, if not in excess of, facilities. M. Baross said, when this difference was referred to, that he did not assume that his plan was applicable to all conditions; on the contrary, it would be necessary to materially modify it whenever an attempt was made to introduce it elsewhere. It was his opinion, however, that it would be practically impossible to apply it in any country where the railroads were not under government control. This opinion was due to the experience he had had in dealing with the Hungarian railroad companies not under government control. His plan was vigorously condemned in advance by all of the practical railroad men to whom he submitted it, and no amount of persuasion on his part could have induced them to accept. Those who are now in some mild measure copying it have been forced so to do solely by the results of its application for the last two years.

It can be said that the supporters in Europe of the "zone" system of fares, when applied to suburban districts, point out that there is no better investment that a railroad company can make than to build up a suburban population on its line from five to twenty miles out from its metropolitan terminus. These are ordinarily dependent on the city, they are too far out to be easily taken by tram-cars of any kind,

and within this short range the value of land is so high that the building of competing steam lines is almost impossible. Thus each new settler gives to the railroad company the promise of a constant and possibly increasing income. The present policy of most of the European railway companies is to give special encouragement to this form of business. This is shown by the tendency to increase the number of trains, to systematically reduce the rates of fare, to make special inducements in the way of commutation tickets, and to freely spend money in enlarging terminal facilities. As to commutation tickets, it may be pointed out that, while in this country the disposition exists to surround these with all manner of qualifications, in Europe there is an obvious disposition to favor the holder of one in every way. He may ride as frequently as he pleases during the period the ticket is in force, and opportunities are freely afforded him to extend it without charge, if for any reason he cannot use it during the specified time. As to the construction of new or the enlargement of old terminal stations, changes which in almost every instance are caused, not by the pressure of long, but of short distance, travel, these are held to be both imperative and useful investments, on the ground that a great increase of this class of business is one of the best guarantees of the future welfare of the corporation; while, unless a company proposes to have its business remain stagnant, it must provide adequate means of taking care of it.

STREET IMPROVEMENT.

In those cities of Europe which have grown to large dimensions, and which were originally laid out with narrow streets, it has been found necessary, in order to meet the demands of modern trade and transit, to make very extensive changes in the way of building new and of widening old streets. The conditions originally presented in Boston were not materially different from those which obtained in Paris and London. In each case the problem of narrow, crooked

streets, unsuited to the new demands, prevailed, and the people of each city have been forced to make improvements. I have had prepared a map of London, showing the changes in the way of street extensions and of street improvements that have been made in the last twenty-five years. It seems to me that this furnishes an object-lesson which can hardly fail to be of value to the people of Boston.

If it were thought desirable, a similar map of Paris could be prepared, which would show that the changes made in that city, since 1850 (which include those carried out under the direction of Baron Haussman), were much more extensive and radical than those made in London. In both cities the need of having great thoroughfares for travel, running through the business centre, has been recognized and complied with. While, as has been pointed out, these have not given the rapid transit that the people of the two cities have desired, they have facilitated local movement to an immense degree. It is impossible to overestimate the intensity of the congestions in travel that would daily occur in Paris if the avenues and boulevards of relatively recent creation did not exist, or in London if that city did not have the Thames embankment, Queen Victoria street, Holborn viaduct, and other equally important thoroughfares made during the last quarter of a century.

The question may fairly be asked if it would not be desirable for the city of Boston to enter upon some work of this kind, if it could be carried on in as favorable a manner and with as favorable results as those just referred to. Congestion of travel in a city is almost as unfortunate in its effects as the congestion of blood in the human system. The veins and arteries of the cities must permit of a free movement, if healthy development is to take place.

The difficulty in the way of entering upon undertakings of this kind in Boston is the great expense which has hitherto attended such enterprises. I have received, from well-informed persons, the statement that a number of the most

important street improvements made in London and Paris were carried through with practically no final expense to the city, and for this reason I have brought back one of the Parliamentary statutes authorizing the laying out of new streets. From this it will be seen that the Board to whom the work has been delegated has had complete power to take such land and buildings in the immediate vicinity of the proposed street as it might consider necessary for its purpose, and, when the street improvements have been completed, has had the power to sell or lease these seized estates in such manner as seemed to it best fitted to promote the public interests. By means of these temporary leases and final sales of improved property, enough money has in some instances been obtained to more than pay for the street extension. If, by the adoption of a like method, substantially similar results could be obtained in Boston, it might be well to seriously consider whether it would not be advisable to cut through the city one or two broad avenues for travel.

OSBORNE HOWES, JR.

APPENDIX.

BETWEEN THE MUNICIPALITY OF BERLIN AND THE GREAT BERLIN HORSE-RAILWAY STOCK COMPANY OF THIS CITY, THE FOLLOWING AGREEMENT HAS BEEN MADE.

Section 1.

The company agrees : —

In consideration of the privilege of using the streets, squares, and highways of the city for the operation of street-railways, as follows : —

- (a) For all lines already built by the company ;
- (b) For lines of which it holds a franchise, or may be accorded a franchise, while this contract is in force ;
- (c) For all lines which it undertakes to operate for another company or person, in any form, be it on its own account or that of others, particularly the line from the Potsdam Gate to Schoeneberg, of which the Great International Horse-Railway Company holds the franchise, but the operation of which is accorded the Great Berlin Horse-Railway Company ;

— to pay the city of Berlin an indemnity consisting of a tax upon the gross income from the transportation of passengers and freight (inclusive of season tickets), to be paid annually during the life of the franchise as established by this agreement. If no transportation of freight occurs, the tax is to be levied upon the gross income from the transportation of passengers, inclusive of season tickets.

Section 2.

This tax will be : —

- (a) With an annual gross income up to 6 million marks, 4 per cent.
- (b) With an annual gross income of from 6 to 7 million marks, $4\frac{1}{2}$ per cent.

- (c) With an annual gross income of from 7 to 8 million marks, 5 per cent.
- (d) With an annual gross income of from 8 to 9 million marks, $5\frac{1}{2}$ per cent.
- (e) With an annual gross income of from 9 to 10 million marks, 6 per cent.
- (f) With an annual gross income of from 10 to 11 million marks, $6\frac{1}{2}$ per cent.
- (g) With an annual gross income of from 11 to 12 million marks, 7 per cent.
- (h) With an annual gross income of from 12 to 13 million marks, $7\frac{1}{4}$ per cent.
- (i) With an annual gross income of from 13 to 14 million marks, $7\frac{1}{2}$ per cent.
- (k) With an annual gross income of from 14 to 15 million marks, $7\frac{3}{4}$ per cent.
- (l) With an annual gross income of from 15 to 16 million marks, or more, 8 per cent.

Section 3.

A part of the tax is to be paid on account to the Central City Treasury during the course of the calendar year, coinciding with the fiscal year, namely, on July 1, and to the amount of one-half of the tax paid for the preceding year. The payment of the remainder is to be made to the same treasury on February 1 of the year following the fiscal year, and is based upon a certificate from the auditing committee of the company, to be furnished the magistrate, in which the amount of gross income from the transportation of passengers and freight (inclusive of season tickets), for the past fiscal year, is certified from the audited books of the company.

To the magistrate is conceded the right of requiring the services of a judicially sworn auditor, to be named by him, in the auditing of said income.

The first payment takes place July 1, 1880, for the time following Jan. 1, 1880. The computation of the tax for these six months is to be based upon the gross income from the transportation of passengers and freight (inclusive of season tickets), as stated in the published statement for 1879.

Section 4.

In case the company credibly shows the magistrate that the aggregate trade-income for a period of three consecutive years has been so meagre that, according to commercial principles, only a dividend below 6 per cent. could be declared for these three years to the stockholders, then a proportional diminution of the tax percentage is placed in prospect.

Until this diminution has been agreed upon, the payment of the tax must continue according to this agreement.

Section 5.

If a general taxation of transportation companies and owners of horses and carriages, based upon the number of horses owned, should be introduced in Berlin, then the amount of such taxes appertaining to this company will be credited to the taxes hereinbefore specified.

Section 6.

In consideration of remission of the obligation to repave the road-bed with better material and new subsoil during the life of the franchise, the company obligates itself to pay for the horse-railway lines completed up to the end of 1879, in addition an annuity of 165,000 marks as acquittance-sum to the municipality, payment to be made July 1 of each year, and January 1 of each succeeding calendar year, to the Central City Treasury.

The first payment is to be made July 1, 1880, for the time from January 1, 1880.

Expenses incurred for changing and repairing the tracks and their supports or stringers, in consequence of these repavings, are borne by the company.

Section 7.

The company is under obligation to keep the pavements and their beds between the rails, as well as for a width of 0.65 and 0.70 metres each side of them, in good condition, pending the duration of this franchise, and to guarantee them in such condition on its expiration; this to apply to pavements already laid or delivered at the laying out of the road, as well as such as are newly laid thereafter.

The right is reserved to conclude a special agreement as to whether, to what extent, and for what compensation this duty devolving on the company of maintaining pavements, cleaning and sprinkling the road-bed, etc., might be assumed by the municipality for the sake of uniformity of administration.

Section 8.

When locations for new lines are granted, the conditions regarding the repair or renewal of pavements are to be specially established.

Regarding the locations already granted, but not utilized by end of 1879, that is —

- (a) From Kronen street to Hausvogtei square ;
- (b) From Schoenhauser Gate to Hacke'schen Market Place ;
- (c) From Coellnischen Fish Market to the corner of Behren and William streets ;

— the obligations regarding repair and renewal of road-bed pavement in the respective grants and franchises hold good in this measure, that for the line *b* the same obligations shall be valid as are imposed upon the company for the lines *a* and *c*.

Section 9.

Reserving the right to specify the trace of locations and special conditions, the following new grants are made the company, in the interest of immediate construction : —

1. The line from the Potsdam Gate through Leipzig street to Spittel Market (off Seydel street) with obviation of St. Gertraudt's church, it being expressly understood, however, that the company obtain from the Great International Horse-Railway Company a quitclaim to all present or prospective franchise for this route ;

2. The connection between the terminal points of the horse-railway at Weidenhammer bridge on one hand, and at the corner of Friedrich and Behren streets on the other hand, and crossing the street "Unter den Linden ;"

3. The continuation of the horse-railway from Monbijou square to the Berlin City Hall ; and

4. From here the connection, *i.e.*, the continuation towards the east of the city and Koepnicker street ;

5. The extension of the line in Müller street from the boundary of the city proper to Duldorf, that is, to the municipal insane retreat there;

6. The extension of the line from the Gesundbrunnen to Rosenthal Gate from the latter to Hacke'schen Market Place.

The company engages itself to begin work upon the lines mentioned in Section 8 against *a*, *b*, and *c*, and those specified above (in Section 9) against 1 to 6, immediately upon permission from the police authorities, for which it is to apply at once, and equip and put into operation these lines without delay. On the other hand the assurance is made the company that the right to construct and operate horse-railway lines in Ritter street, in the street "Unter den Linden," in the projected Kaiser-Wilhelms street, in Friedrich street, and in Louisen street will be granted by the city to another contractor only after the company, upon precedent enquiry by the magistrate, has failed to declare within a period of four weeks that it is willing to build and operate these lines according to the terms of the prospective grant.

Section 10.

The company is released from the construction of the loop-routes —

1. Between the Gesundbrunnen and Pankow;
2. From Bueschings square to the square at the corner of Weber and Great Frankfurter streets;
3. Between Treptow and Rixdorf;
4. From Tempelhof over Lichterfelde and Steglitz to Schoeneberg.

Section 11.

The duration of the franchise for all lines now ready for traffic is established at thirty years, from Jan. 1, 1880, to Dec. 31, 1909.

All the other lines made ready for operation within five years, dating from Jan. 1, 1880, are subject to the same definition regarding the terminal point of the franchise granted or to be granted them.

Regarding the lines made ready for travel later than that, the right of agreement is reserved.

Section 12.

The Great Berlin Horse-Railway Stock Company furthermore agrees to abide by the general conditions for the establishment of street-railways as attached to this agreement and subscribed by the company, in such degree as said conditions are not modified by this agreement.

Section 13.

The bond required from the company is increased from 61,500 marks to 100,000 marks, and will be held for the fulfilment of all obligations resting upon the company.

Section 14.

Without detriment to any other rights of the city in case of any violation of the obligations which rest upon the company, the municipality has the right, in case the payment of the tax from the gross income stipulated in Sections 1-8, or of the rental for pavements according to Section 6, is not made within six months after it is due, to cancel all agreements made with the company, and the franchises granted it.

Section 15.

All conditions of contracts concluded between the city of Berlin and the Great Berlin Horse-Railway Stock Company now existing, and of franchise granted by the fiscus, as far as the rights and duties of the same have been conveyed to the city; and all franchises granted by the city, which conflict with the conditions established hereinbefore, are hereby repealed.

BERLIN, July 26, 1880.

MAGISTRATURE OF THE ROYAL CAPITAL AND RESIDENCE CITY
HERE.

Signed.

DUNCKER,
DR. WEBER,
MEUBRINK.

BERLIN, August 18, 1880.

GREAT BERLIN HORSE-RAILWAY STOCK COMPANY.

Signed.

DIITMANN,
FISCHER-DICK.

ADDENDUM

To the agreement between the municipality of Berlin and the Great Berlin Horse-Railway Stock Company, containing the

GENERAL CONDITIONS

for the establishment of street-railway plants in Berlin.

ALTERATIONS IN EXISTING PLANTS.

Section 1.

All widening or altering of streets or bridges; all altering or transposing of telegraph, pneumatic mail, water-pipe, drainage, and lighting plants; of fountains, pumps, sanitaries, landscape gardening, or other public plants necessitated by the laying out of the railway plant, — are to be made according to the requirements of the municipal authorities in charge, at the expense of the contracting party.

Section 2.

Neither by the section of the rails, nor the construction of the tracks, nor the laying out of the road generally, may the travel of other vehicles over the road be made more difficult in any way. Rail sections and track construction that do not conform to these conditions must, upon demand of the magistrature, be replaced by other more suitable ones, without compensation.

PAVING OF THE RAILWAY.

Section 3.

The railway, that is, that portion of streets or bridges which is included between the rails and in a width of 0.65 or respectively 0.70 metres each side of them, is to be paved at the expense of the contracting party, and in a manner to be plainly discernible from the rest of the paving, with avoidance of the hitherto usual stretching-courses.

The various street-routes must be paved, respectively secured

in their entire width with the same kind of pavement-bed, with material of uniform hardness and durability, and worked in a uniform manner. The contracting party is therefore under obligation to construct the pavement-bed required for the paving of the railroad in such manner and of such materials, and to obtain the required paving stones from such quarries, and have the same worked in such a manner, as shall be prescribed by the municipality for the purpose.

To the same extent the contracting party is under obligation to maintain the pavement-bed and paving of the railroad as long as the franchise is in force.

To maintenance belongs also the renewal of pavement-bed, if according to the views of the municipal building-commission mere repairs are insufficient.

If, when such renewals of paving or pavement-bed are required, one or the other of the streets or portions of streets utilized by the road should be paved or secured with a different kind of pavement-bed, or a different kind of stone, or with asphalt, wood, or other paving, then the contracting party is under obligation to pave, respectively secure, the railroad in similar manner and at his expense.

In place of the last-mentioned obligation, and for the horse-railway lines constructed up to end of 1879 as per Section 6 of the agreement between the municipality of Berlin and the Great Berlin Horse-Railway Stock Company of present date, is substituted the indemnity of 165,000 marks, to be paid annually by the company to the Central City Treasury.

Section 4.

With the renewals of pavement and paving-bed in streets or portions of streets already utilized by the road, as prescribed in Section 3, the contracting party is held, on demand of the magistrature, to replace the rails and track construction existing in such streets, with others that permit a secure and durable connection with the projected pavement. The sectional profiles and methods of construction of rails and tracks selected for this purpose are subject to the approval of the magistrature.

OBLIGATION TO DELIVER THE OLD PAVING MATERIALS TO THE MUNICIPALITY.

Section 5.

As far as the contracting party has to pave the streets with new materials, the paving stones and paving materials already on hand in these stretches, so far as they belong to the municipality, are to be delivered to the same and transported at the expense of the contracting party to such localities as may be designated.

MATERIALS FROM PRIVATE PROPERTY TO BE DELIVERED TO THE OWNERS.

Section 6.

If, in consequence of new regulations concerning the repartition of streets, paving and other materials are taken up that do not belong to the municipality, then said materials must be delivered to the respective owners.

STATIONS AND WAITING-ROOMS.

Section 7.

The contracting party is held to build at his own expense such stations, transfer and waiting rooms, as are deemed necessary by the magistrature, or to establish them in adjoining houses.

ROADWAY AND PAVEMENT TO BE MAINTAINED, CLEANED, SPRINKLED, AND LIGHTED.

Section 8.

As long as the franchise is in force, the contracting party is required, at his own expense, to keep in good condition, as directed, not only the roadway and all devices for its drainage and other auxiliaries, but also all bridging where the gutters had to be bridged over during or in consequence of the construction of the road, to clean them according to municipal regulations, and to sprinkle them whenever asked to do so. The contracting party is also held to remove at his expense all garbage, mud, and snow swept from the roadway and all ice removed therefrom.

The municipality, however, reserves the right, if any delay in complying with the preceding requirements is attended with danger,

or an agreement has been reached regarding their fulfilment, to have the work done by its own employees, and the expense of such work is to be made good to the municipality at once and in full by the contracting party.

SUBTERRANEAN DRAINAGE WORKS, BORDERING AND CURB STONES, BECOME PROPERTY OF THE MUNICIPALITY.

Section 9.

The subterranean drainage plants required for the drainage of the streets or adjoining properties, as well as all gutters, border and curb stones, constructed at the expense of the contracting party, go into possession of the municipality on the day of conveyance.

REGARDING ALTERATION ON AND ABOUT STREETS.

Section 10.

In case alterations become necessary upon the streets or roads touched by the railway, which alterations would necessitate changes in the road-bed or temporary removal of the rails, the contracting party can claim no indemnity, and must have the changes, transposals, or removals required by the city authorities or the magistrature made at his own expense.

RENEWAL OF STREETS, ETC., IF THE RAILWAY IS DISCONTINUED OR REMOVED.

Section 11.

If the railway plant is discontinued, or must be changed, transposed, or removed, then the contracting party is held, without indemnity and within a prescribed time and at his expense, to have the changes, transposals, or removal of the tracks made, and to renew the streets, gutters, bridges, and other displaced features according to the directions of the municipal board of construction.

INTERRUPTION OF OPERATION NOT ALLOWED.

Section 12.

The contracting party is held to keep the road in orderly operation during the life of the franchise, and may not interrupt the same without special permission from the proper authorities.

STOPPING OF OPERATION.

Section 13.

Should the contracting party stop the orderly running of the road without particular permission, the magistrate has the right to rent the road to other persons, and if he should not succeed in this, to remove the road, sell the material, and have the streets and other places renewed and repaired at the expense of the contracting party.

INTERRUPTION OF OPERATION ON ACCOUNT OF PUBLIC WORKS.

Section 14.

For detriment to the use and operation of the road which is caused by ordinances or operations of the municipality or other authorities, the contracting party cannot require any indemnity.

CROSSING AND JOINT USE OF RAILS FOR THE RUNNING OF OTHER ROADS.

Section 15.

If, according to the opinion of the magistrature, a crossing or a joint use of short distances of the rails, not exceeding 400 metres in round numbers, or a connection with the same by other street-railways, must take place, then the party undertaking the line mentioned in this franchise must submit thereto, as well as to possibly necessary alterations in the track-plant, without any claims on the municipality whatever; however, the obligation shall be imposed upon the party admitted to such joint use, of compensating the party undertaking the lines approved herewith for one-half of the expense entailed in laying out the distance thus jointly used. Upon which of the two roads the obligation of bearing the expense of any possible alteration and maintenance of the jointly used plant shall devolve, the magistrate will, in default of amicable agreement, decide.

TRANSPORTATION OF STREET SWEEPINGS, RUBBISH, ETC.

Section 16.

The party of the second part is held, in case he is required by the magistrate, to transport on his road at night wagons which

serve for the removal of street sweepings, rubbish, kitchen offal, etc., exclusive of sewage, for a reasonable compensation to be previously determined.

The same shall hold good in case a system of transporting corpses is established.

TARIFF AND TIME-TABLE.

Section 17.

In determining the tariff and time-table for the various routes, the consent of the magistrate is required. On Sundays and holidays the prices may not be raised, neither may any other conditions be imposed that are burdensome to passengers.

EXPIRATION OF FRANCHISE.

Section 18.

The franchise of the lines specified in the main agreement as to be newly built expires, unless work on the construction of the line in question is begun within six months at the latest after the police license has been granted, or if the running of the line has not begun within the period set down in the special conditions.

The municipality of Berlin is released from all obligations arising from a franchise it has granted, if the party of the second part does not succeed in obtaining, within three years after the grant, the required permits from the trade and police authorities.¹

CONVEYANCE OF THE SAME TO OTHER PERSONS.

Section 19.

Without the approval of the municipal authorities the contracting party may neither relinquish the rights granted him to a third party, nor delegate to such a party their execution, nor may he acquire the rights granted the projector of another urban horse-railway, nor undertake the exercise of the same.¹

¹ See changes of these conditions which follow the supplementary agreement further on.

OBLIGATION OF THE CONTRACTING PARTY AFTER EXPIRATION OF THE FRANCHISE.

Section 20.

After the franchises have expired the municipal authorities have the right either to take over the railway, or to require of the party of the second part that he, upon removal of the road, restore the streets, at his expense, to perfectly good condition, according to the requirements of the street commissioners. In the former case, the tracks, together with the pavement-bed and paving, at once pass over without remuneration into the absolute possession of the municipality, and the party of the second part has to deliver the road with its transfer-stations and waiting-rooms in serviceable condition.

The entire remaining animate and inanimate property is to be relinquished to the municipality, in case it wants to take it, after amicable agreement, or for a set price. If such price cannot be agreed upon, it is to be determined by referees. One of the referees is named by the magistrate, the other by the party of the second part.

If one or the other party fails to proceed to the naming of a referee within four weeks after having been called upon to do so by the other party, then the right accrues to the latter to name also the second referee. If the referees cannot agree, the decision is made with the assistance of an arbitrator, to be named by the referees. The arbitrator is named by the magistrate in case the referees cannot agree upon one within four weeks.

FURNISHING OF SECURITY.

Section 21.

For the fulfilment of the obligations undertaken, especially for those expenses which arise when the contracting party fails to perform what devolves upon him and the magistrate steps into his place, the following stand security:—

(a) The materials furnished by the contracting party in the railway plant;

(b) The bonds already furnished by the contracting party and which may be increased, whether already deposited, or still to be,

with the magistrature, and consisting of government or other depositable securities, and which, as soon as they are drawn upon, must always be made good to the original amount, and must be delivered before beginning work on the road, within four weeks after delivery of these conditions, under penalty of forfeiting the franchise.

FORFEITURE OF BONDS.

Section 22.

If by fault of the contracting party construction has not been begun or the road not put into operation within the period set in the special conditions, then aforesaid bonds, as far as they are represented by materials, are forfeited entirely, and as far as they are represented by money, to the amount of one-fourth of the sum deposited.

In cases in which the magistrate is entitled to have recourse to the bonds, this happens to the amount of the sum specified by him, by non-judicial conversion into money of a suitable portion of the values composing the bonds at the stock exchange at current rates. To the party of the second part, who is to be notified when this happens, the right of appealing to the courts is reserved.

BERLIN, July 26, 1880.

MAGISTRATURE OF THE ROYAL CAPITAL AND RESIDENCE CITY
HERE.

Signed.

DUNCKER,
DR. WEBER,
MEUBRINK.

BERLIN, Aug. 18, 1880.

GREAT BERLIN HORSE-RAILWAY STOCK COMPANY.

Signed.

DITTMANN,
FISCHER-DICK.

SUPPLEMENTARY AGREEMENT TO THE AGREEMENT OF THE MUNICIPALITY OF BERLIN WITH THE GREAT BERLIN HORSE-RAILWAY STOCK COM- PANY OF JULY 26-AUGUST 18, 1880.

In completion of the agreement concluded July 26-August 18, 1880, between the municipality of Berlin and the Great Berlin Horse-Railway Stock Company, especially in further elucidation of Section 8 of the same, the following supplementary contract is subscribed to, the subject of which consists in the permission granted the company, in consideration of its paying a stated amount annually, to lay down and maintain horse-railway tracks in Berlin and its immediate vicinity, and the right to operate upon these tracks a horse-railway enterprise.

Section I.

With the proviso which appears at the beginning of Section 9 of said principal agreement, the following lines are newly granted the company by the municipality :—

- (a) From the corner of Prinzenallee and Badstrasse through Pank, Reinickendorfer, Fenn, Perleberger, Birken, Lessing, and Altona streets, over the Great Star through the Hofjäger-Allee, Friedrich Wilhelm street, about Lützow square, through Maassen street, Bülow street through the railroad viaduct, through York and Gneisenau streets, along the Hasenhaide, through Fichte, Grimm, Admiral, and Adalbert streets, along the Engelufer to the Schillings bridge ;
- (b) From the new cemetery of the Jewish congregation and Georgenkirchhof in Weissensee, through the Prenzlauer Allee, Danziger street and Kastanien Allee, Invaliden street, Louisa street, over the Marschall bridge, through Dorothy street to the City Railway Station, Friedrichstrasse ;
- (c) From Schlesischenstrasse over Lausitzer square, through Waldemar, Bukower, Dresdener, and Ross streets to the Kölnischen Fish Market ;
- (d) From Jannowitz bridge to Alexander square ;
- (e) From the Molkenmarkt to the Spittelmarkt ;

- (f) From Kleinen Präsidenten street through Burg street, over the Friedrichs bridge, the Lustgarten, and the Schlossfreiheit to the Schlossplatz ;
- (g) From Behren street through Markgrafen, Ritter, and Reichenberg streets ;
- (h) From the Eastern Railway Station through the Grünen Weg, Blumen street to Alexander street, and prospectively, after the opening of the newly projected street between Blumen and Stralauer streets, to the latter ;
- (i) In Friedrich street from Koch street to Behren street ;
- (k) In Jerusalem street from Kronen street to Krausen street ;
- (l) From Hauswogteiplutz through Oberwall and Jäger streets to the Werderschen Market ;
- (m) From the Schlossplatz over the Lange (respectively Kurfürsten) bridge, through König street to Spandauer street.

With all these lines the municipality reserves the right of altering their traces, but to the extent only of not disturbing the direction of the lines and not interfering with the general plan of the network of street-railroads indicated above.

Section 2.

The line at *m* of Section 1, however, is granted only in case the construction of the projected Kaiser Wilhelm bridge between the Friedrichs and Langen (or Kurfürsten) bridges is realized, and the line at *e* with the proviso that the laying out of the railway is permitted by all the authorities concerned without the widening of Gertrandt street or the reconstruction of Gertrandt bridge.

Section 3.

With the lines specified in Section 1, the definitions of Section 1 of the "General Conditions" of the main agreement find application only in case of the line at *m* (Schlossplatz to Spandauer street).

On the other hand, the company pays the Central City Treasury as a single contribution for the following lines and portions of lines : —

- (a) Gesundbrunnen to the northern boundary of the Thiergarten, 30,000 marks ;
- (b) Southern boundary of the Thiergarten to Kurfürsten street, 40,000 marks ;
- (c) Hasenhaide to Engelufer, 40,000 marks ;
- (d) Molkenmarkt to Spittelmarkt, 700,000 marks ;
- (e) Köllnischer Fish Market to Schlesische street, 160,000 marks ;
- (f) Jannowitz bridge to Alexander square, 10,000 marks ;
- (g) Kleine Präsidentenstrasse to Schlossplatz, 20,000 marks.

Each of these amounts is to be paid independently of the others as soon as the line in question has been approved definitely by the proper authorities.

Through these contributions the company is released from the obligation, contained in Section 1 of the "General Conditions," to assume all widening of streets and widening and alterations of bridges necessitated by the laying out the road, as far as the lines from *a* to *b* in Section 1 of this supplementary agreement are concerned ; outside of this the rest of the definitions contained in Section 1 of the "General Conditions" hold good for these lines just mentioned.

Should one of the lines specified in this paragraph from *a* to *g* fail of construction, then the company is released from the single payment allotted to the line in question.

Section 4.

The company is under obligation to begin work upon, complete, and put into operation those portions of the line described in Section 1, letter *a*, lying between Strom street and Pringen Allee (corner of Badstrasse) and from Bülow street to Hasenhaide, as well as the lines in Section 1, letters *d* and *e* (Jannowitz bridge to Alexander square, and Molkenmarkt to Spittelmarkt), immediately upon approval of the respective authorities, for the bestowal of which it is to apply immediately upon the signing of this contract.

The company must have the rails on the distance from Bülow street, corner of Mannstein, to York street, corner of Horn, completed at the latest synchronously with the projected work of regu-

lating these streets to be undertaken by the municipality, to the extent to which it (the company) shall obtain for this purpose the special permission of the respective authorities, in case the grant for the distance from Bülow street to Hasenhaide should up to that time not have been bestowed.

Of the line described in Section 1, letter *b*, the company is not obliged to build the section between the Connecting Railway to the cemeteries in Weissensee until as soon after December 31, 1888, as the magistrate may require.

As far as this line lies outside of the city proper, the company is not obliged to construct it before the proper authorities have granted it a license for such construction under conditions which are at once deemed acceptable by the company, or, in the contrary case, under such conditions as may be deemed acceptable by the board of referees for which provision is made in Section 20 of the "General Conditions" of the main agreement.

All the other lines outside of these distances the company must construct and put into operation by Dec. 31, 1888; as regards the line specified in Section 1, however, the company is released from this obligation in case a widening of König street between Burg street and Spandauer street is required by the proper authorities.

Section 5.

The duration of the franchise of the lines at present operated by the Great Berlin Horse-Railway Stock Company, whether on its own account or for others, as well as all lines granted before and by this agreement, and all such grants as may be made up to Dec. 31, 1889, is fixed for Dec. 31, 1911.

Section 6.

So far as the Sections 1 to 5 do not otherwise specify, all the conditions of general purport accepted by the contracting parties remain unchanged; this holds good particularly for the tax specified in Sections 1 and 2 of the main agreement, and for the paving rental defined in Section 6 of the same agreement, as well as in the supplementary agreement of May 3 and June 13, 1883, respectively.

Section 7.

The stamp dues for both copies of this agreement are borne by the company.

BERLIN, Nov. 6, 1884.

GREAT BERLIN HORSE-RAILWAY STOCK COMPANY.

Signed.

DITTMANN,
VON KÜHLEWEIN.

BERLIN, Nov. 17, 1884.

MAGISTRATURE OF THIS ROYAL CAPITAL AND RESIDENCE CITY.

Signed.

VON FORCKENBECK,
DR. WEBER.

The general conditions of the main agreement are changed in Sections 18 and 19; these paragraphs, according to the new agreement, read as follows:—

EXPIRATION OF FRANCHISE.

Section 18.

The municipality of Berlin is released from all obligations arising out of a franchise conferred by it, if the contracting party does not succeed in obtaining licenses from the commercial, respectively police, authorities within three years after the grant of the special franchise.

If the contracting party to whom locations of horse-railway lines is granted delays in applying for a license or beginning their construction, then the magistrate is entitled to call upon him to apply within a fixed period to the municipality and other authorities concerned for permission to construct the line.

If the contracting party lets this period pass by, or if he, after obtaining permission from all authorities concerned, fails to proceed to construction within a period also to be fixed by the magis-

trate, then the magistrate has the right, either to declare the rights springing from the agreement concerning this line as forfeited, or himself to obtain the franchise in the name of the contracting party, and to build and operate the line, or have it built and operated, according to the provisions of the agreement, at the expense of the contracting party.

TRANSFERAL OF THE SAME TO OTHER PERSONS.

Section 19.

The contracting party may neither cede the rights granted him to a third party, nor make over to such a one their exercise, neither may he on his part acquire the rights granted any other contractor for urban railways, nor undertake their exercise without first obtaining the consent thereto of the municipal authorities.

It is therefore not permitted the contracting party to allow any other contractor the use of his present or future plants for the operation of a street-railway, without obtaining the consent of the magistrate thereto.

Neither may he without consent of the magistrate lay rails in streets, portions of streets or squares, within the limits of Berlin proper, nor outside these limits, in such localities as are maintained by the municipality.

Neither is he entitled without consent of the magistrate to begin operations upon already constructed plants of other contractors.

If the contracting party acts in contravention of these provisions, or if he charges a tariff of fares not approved by the magistrate (Section 17), then the magistrate has the right to demand, for each day of such violation, and separately for each line on which such violation has happened, a penalty of 100 marks.